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Subject: Preliminary Environmental Fate and Ecological Risk Assessment for the Registration Review of Ethalfluralin
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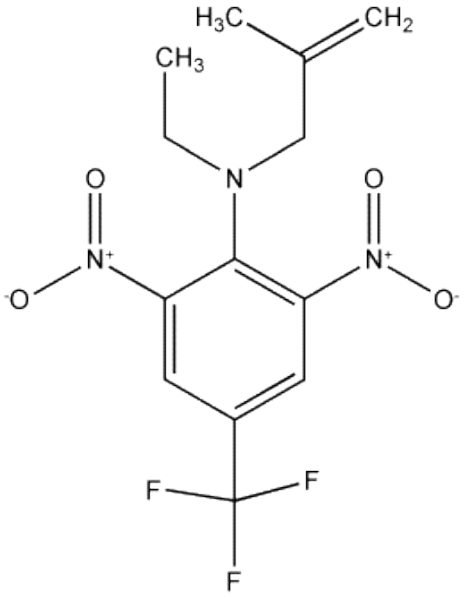
The Environmental Fate and Effects Division (EFED) has completed the ecological effects and environmental fate preliminary risk assessment conducted as part of the registration review of the herbicide ethalfluralin. An evaluation of ecological risk to aquatic and terrestrial organisms as a result of the use of ethalfluralin is summarized in the Executive Summary and the Risk Characterization sections of the attached document. A separate document containing a preliminary problem formulation was prepared for ethalfluralin (DP Barcode D382172) in March 2011 and was released for public comment.

OFFICE OF CHEMICAL SAFETY AND POLLUTION PREVENTION

Preliminary Environmental Fate and Ecological Risk Assessment for the Registration Review of Ethalfluralin



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1. Executive Summary

Scope and Rationale for Registration Review Risk Assessment

This document contains the environmental fate and ecological risk assessment for the registered uses of the chemical ethalfluralin. Ethalfluralin is a member of the dinitroaniline class of herbicides that inhibits the formation of the cell wall in plants (both aquatic and terrestrial) and by initiating desiccation of the xylem and phloem systems in plants.

Ethalfluralin Current Registered Uses

Ethalfluralin is soil incorporated (mechanically or by wetting in) and used on alfalfa, clover, dill, bean (dry), cucurbits, lentils, mustard, oilseed (sunflower, jojoba *etc.*), oilseed (crambe, rapeseed), oilseed sunflower, peanuts, peas (dry), potatoes and soybeans. Both flowable and granular formulations are registered for various crops. Also depending on the crop site, ethalfluralin may be applied pre-emergence, post-emergence, or in the fall during fallow periods. The maximum label rates for the various crop sites range from about 0.75 to 1.69 pounds of active ingredient (a.i.) per acre.

Environmental Fate and Exposure Summary

Ethalfluralin residues have the ability to reach nearby water bodies in sediment borne in runoff or in a dissolved state via spray drift or runoff. Exposure modeling indicates that under most use conditions aquatic exposure is primarily from spray drift at the time of application and that transport via runoff is primarily (but not exclusively) in soil-bound residues (erosion) rather than dissolved phase. This is consistent with ethalfluralin's relatively high soil organic carbon – water partition coefficient (K_{foc} range of 3967-8083 mL/g).

The environmental persistence of ethalfluralin varies significantly with the different transformation pathways that are available after application. Most of the chemical that reaches the soil system will be transformed within 2 months based on the aerobic soil biotransformation with half-lives ranging from 17 to 46 days. Ethalfluralin transformation in soil sediment is relatively rapid with an anaerobic aquatic half-life of 1.6 days (single test). If sunlight is present ethalfluralin transformation can be quite rapid (aquatic photodegradation half-life value of 6.3 hours). This may greatly accelerate the degradation of any dissolved residues present in clear surface waters but the effect of photolysis on most aquatic systems is not expected to be significant due to turbidity and light attenuation in most water bodies. Volatilization can be a significant mechanism of dissipation (vapor pressure of 8.2×10^{-5} mm Hg at 25°C is indicative of this) and degradation in the atmosphere within a few hours or days is predicted.

Ecological Effects Summary and Risk Conclusions

When estimates of ethalfluralin exposure in terrestrial and aquatic environments are compared to the available ecotoxicity data, the results indicate a potential for risk above the level of concern to both aquatic and terrestrial taxa from proposed uses of ethalfluralin. Aquatic taxa were determined to be at risk from both acute and chronic exposure while terrestrial animals were at risk from chronical exposure.

Ethalfluralin is very highly toxic to aquatic animals on an acute exposure basis. In general, risk quotients (RQ) for aquatic organisms are calculated considering estimated exposure concentration (EEC) in the surface water column for each crop. Acute risk concerns exist for federally listed threatened/endangered (hereafter referred to as "listed") freshwater fish and invertebrates (RQs 0.06 – 0.39) and estuarine / marine fish and invertebrates at the highest application rates (RQs 0.05-0.07). Chronic risk concerns exist for listed and non-listed freshwater fish from multiple application rates (RQs 1.0 to 3.4) and to estuarine/marine fish at the highest application rate (RQ = 1.13) but not to aquatic invertebrates. Sediment-dwelling freshwater invertebrates were also determined to be at risk from chronic exposure to residues in sediment (RQs 1.3-4.0). Risk was identified to non-listed aquatic vascular plants only at the highest application rates (RQ = 1.7). Risk to listed vascular plants was identified for several application rates ranging from 1 to 1.7 lbs ai/A with RQs from 3 to 10.4. Risk to listed non-vascular plants was only identified at the highest application rate of 1.7 lbs ai/A (RQ = 1.1).

For terrestrial wildlife, ethalfluralin is practically non-toxic to birds, mammals, and terrestrial insects on an acute exposure basis. Ethalfluralin is classified as practically non-toxic to honey bee adults on an acute contact exposure basis. How ethalfluralin impacts of adults bees from chronic exposure or larval bees from acute or chronic exposure remain uncertain. Additional studies addressing the pollinator data gaps for chronic adult exposure and acute and chronic larval exposure would help reduce this uncertainty.

No risk is identified for either non-listed or listed birds, reptiles, or terrestrial-phase amphibians, from acute or chronic exposure to ethalfluralin. Chronic risk to mammals is identified for uses involving spray applications (RQs range from 0.01 to 3.3). RQs for small- and medium-sized mammals (15 g and 35 g mammals respectively) exceed the chronic risk LOC of 1.0 for those animals foraging on short grass, tall grass, broadleaf plants following uses on alfalfa, cucurbits, potatoes and sunflower with application rates at 1 to 1.69 lbs a.i./A. Modelling suggests there may be potential chronic risk to mammals from consuming fish containing residues that have accumulated through trophic transfer with one LOC exceedance at the highest application rate (RQ 1.1).

Risk to terrestrial plants was identified for every use of ethalfluralin (non-listed and listed RQs ranging between <0.1 – 131), and both runoff and spray drift processes contribute to the overall risk.

Data gaps to improve understanding of ecological effects

The ecological database for ethalfluralin has a number of outstanding data gaps as follows:

1. Whole sediment toxicity testing with an estuarine/marine sediment dwelling invertebrate **(Guideline 850.1735)**
2. Tier 1 Acute oral toxicity to adult honeybees **(Non-guideline; OECD 213)**
3. Tier 1 Acute oral toxicity to larval honeybees **(Non-guideline; OECD 237)**
4. Tier 1 Chronic oral toxicity to adult honey bees **(Non-guideline)**
5. Tier 1 Chronic oral toxicity to larval honey bees **(Non-guideline)**
6. Tier 2 Pollinator feeding/semi-field study - The need for these studies is contingent upon the results of lower tier bee studies **(Non-guideline)**
7. Tier 2 Pollen and nectar residue studies – The need for these studies is contingent upon the results of lower tier bee studies **(Non-guideline)**
8. Tier 2 Field testing for pollinators – The need for field testing is contingent upon the results of lower tier bee studies **(850.3040)**

2. Mechanism of Action

Ethalfluralin is a member of the dinitroaniline class of herbicides which are selective herbicides mainly used in control of certain annual and broadleaf weeds. Ethalfluralin functions by inhibiting the formation of the cell wall in plants (both aquatic and terrestrial) and by initiating desiccation of the xylem and phloem systems in plants. Specifically, they inhibit microtubule synthesis necessary in the formation of cell walls, but also vital for mitosis, as microtubules facilitate the process by ensuring correct positioning and orientation of the mitotic spindle apparatus. Microtubules are also involved in the determination of cell division site based on the geometry and polarity of the cells. Dinitroaniline herbicides are absorbed somewhat by plant root systems, and to a greater extent by young seedling shoot organs such as the hypocotyl or coleoptile. Little or no translocation of these herbicides occurs in plants (Parka and Sopa, 1977).

Additionally, ethalfluralin has a registered label with another active ingredient, clomazone. The formulation is used for control of broadleaf weeds in melons, pumpkins, squash, and watermelons. Clomazone acts by inhibiting carotenoid synthesis so that affecting plants are devoid of pigment, and therefore cannot photosynthesize.

3. Use Characterization

3.1 Labelled Use

Current labels (**Table 1**) allow the usage of ethalfluralin on alfalfa, clover, dill, bean (dry), cucurbits, lentils, mustard, oilseed (sunflower, jojoba *etc*), oilseed (crambe, rapeseed), oilseed sunflower, peanuts, peas (dry), potatoes and soybeans. Depending on the crop, ethalfluralin may be applied pre-emergent, post-emergent, or in the fall prior to a spring planting. More details on ethalfluralin maximum application rates and application methods are presented in **Table 2**. The maximum application rates are specified as a single or crop-cycle basis. Liquid formulations of ethalfluralin are applied as a band/broadcast surface spray with ground equipment or via chemigation applied through sprinklers. However, the granular formulation is applied to the soil surface with mechanical incorporation or incorporation through rainfall and/or sprinklers. Although not explicit on labels, it appears that applications are only made once per year / growing season (September 2015 correspondence from Office of Pesticide Programs' Biological and Economic Analysis Division; BEAD).

Table 1. Summary of ethalfluralin product labels registration numbers.

Registrant	**Reg. No.** [1]	**Use Sites and SLN ID, if applicable.** [1]
Dow AgroScience -FIFRA Section 3	62719-184 (Granular) 62719-188 (EC) + SLNs (see below)	1. Dry beans 2. Dry peas 3. Oilseed – Crambe, flax seed, rapeseed, *etc*. 4. Oilseed – Sunflower, *etc*. 5. Oilseed – Safflower 6. Peanut 7. Alfalfa, clover (SLNs= Special Local Needs Labels) 8. Lentils (SLNs)
Dow AgroScience Special Local Needs	62719-184 (Granular) SLNs	SLN - MT-06-0003 1. Lentils SLN - ND-090004 1. Yellow Mustard SLN - ND-050010 1. Lentils
Dow AgroScience Special Local Needs	62719-188 (EC) SLNs:	SLN - NV-950001 + SLN - ID-950020 + SLN - MT-01-0002 + SLN - WY-030005 + SLN - OR-940037 + SLN - WA-940018 1. Alfalfa for seed

Loveland FIFRA Section 3	34704-610 (EC) 34704-836 (EC)	OR-120002 SLN WA-0900l3 SLN 1. Cucurbits group (Cucumbers, *etc*.)
Loveland Special Local Needs	34704-610 (EC)	OR-120002 SLN WA-0900l3 SLN 1. Dill

[1] EC= Emusifiable concentrate; SLN=special local needs

Table 2. Summary of ethalfluralin application rates and methods by crop site.

Crop[1]	*Application Timing*	*Single Application Rates (lbs a.i./A[2]*		*Application Codes**	*Soil Type Specific Rates*	*Label Information*
		Maximum	*Range*		*Variation max . rate with soil type, if applicable[3]*	*Reg. No.*
Alfalfa (ID, NV, WA & WY, MT, OR)	Pre-emergence	**1.69**	1.51 - 1.69	EC-1 (ID,MT); EC-2 (All); EC-3 (OR)	C = 1.7, M = 1.5, F = 1.3	62719-188 (EC) 24c registrations
	Germination	**1.69**	1.69	EC-2 (NV)		
	Established plantings	**1.52**	1.36 - 1.52	EC-2 (WA, WY); EC-3 (WA)		
	Late tillering	**1.51**	1.51	EC-1 (NV)		
Beans (dry)	Pre-plant	**1.69**	1.13 - 1.69	EC-2, Gran-F & Gran-2	F = 1.7, M = 1.5, C = 1.3	62719-184 and -188
	Pre-emergence	**1.69**	1.13 - 1.69	EC-3		
	Fall	**1.70**	1.13 - 1.69	Gran-F		
Clover (WY)	Established plantings	**1.50**	1.13 – 1.50	EC-2 (WY)	NA	62719-188 (EC) SLN WY-30005
Cucurbits (Cucumber "CU", Melons, Pumpkin & Squash "SQ" summer/ winter)	Pre-plant (CU, PM), At seeding (All), Pre-emergence (All) & Post-emergence (PM, SQ)	**1.70**	1.13 – 1.70 0.40- 1.20 (w clomazone)	EC-1	F = 1.7, M = 1.5, C = 1.1 F = 1.2, M = 0.8, C = 0.6	34704-610 34704-836
Dill (OR, WA)	Pre-plant & Post-plant	**1.13**	0.56 - 1.13	EC-1 (OR, WA)	NA	34704-610 SLN's OR-120002 WA--090013
Lentils (MT & ND)	Stubble (MT) Stubble (ND)	**0.750** **0.950**	0.750 0.55 – 0.75	Gran-2 (MT & ND)	F = NS, M = 0.75, C = 0.75	62719-184 24c - MT-06-0003 24c - ND-090004 24c - ND-050010

Crop[1]	*Application Timing*	*Single Application Rates (lbs a.i./A[2]*		*Application Codes**	*Soil Type Specific Rates*	*Label Information*
		Maximum	*Range*		*Variation max . rate with soil type, if applicable[3]*	*Reg. No.*
Mustard (ND)	Stubble	**0.95**	0.550 - 0.950	Gran-2 (ND)		62719-184 24c -ND-09004
Oilseed – Sunflower, Jojoba, *etc*. group[3]	Spring (any time after Jan. 1), fall	**1.7**	0.550 – 1.70	Gran-2 & Gran-F EC-3 Gran-F	F = 1.7, M = 1.5, C = 1.3	62719-184 and -188
Oilseed – Crambe, Rapeseed (canola), *etc*. group[4] Except CA.	Spring before planting or fall	**0.95**	0.550 - 0.950	EC-2, Gran-2 & Gran-F, Except CA	F = 0.95, M = 0.75, C = 0.55	62719-184 and -188
Oilseed - Safflower	Pre-plant	**1.15**	0.550 - 1.15	Gran-2 & Gran-F	F = 1.15, M = 0.95, C = 0.75	62719-184 and -188
Peanuts	Pre-plant	**1.15**	0.563 - 1.13	EC-2, Gran-F & Gran-2	F = 1.13, M = 0..938, C = 0.750	62719-184 and -188
Peas (dry) Except CA.	Pre-plant	**0.750**	0.750	EC-2, Gran-F & Gran-2	Max. rate does not vary.	62719-184 and -188
	Fall	**0.750**	0.750	Gran-F		
Potatoes **	After planting but prior to emergence	**1.028**	0.500- 1.000	EC-2 & EC-3	F = 1.00, M = 1.00, C = 0.75	62719-188 only
Soybeans	Pre-plant	**1.31**	0.56- 1.31	Gran-2 & Gran-F	F = 1.31, M = 1.13, C = 0.75	62719-184 and -188
	Fall	**1.31**	0.56 - 1.31	Gran-F	F = 1.31, M = 1.13, C = 0.75	62719-184 and -188

* Application Codes:
EC: Applications with an emulsifiable concentrate (EC) formulation type (On Dow labels the EC is identified as an "HFP", this appears to refer to the use of hexafluoropropylene copolymers in the formulation).
EC-1: Band/broadcast (not incorporated) applied by low pressure ground sprayer

Crop[1]	Application Timing	Single Application Rates (lbs a.i./A[2]		Application Codes*	Soil Type Specific Rates	Label Information
		Maximum	Range		Variation max . rate with soil type, if applicable[3]	Reg. No.

EC-2: 3" Incorporated applied by spreader/incorporation equipment
Gran-F: Impregnated with dry fertilizers (3" Incorporated) applied by spreader/incorporation equipment
EC-3: Chemigation applied through sprinklers
Gran-2= Granular formulation: requires 2 separate incorporation steps, the first incorporation needs to occur within 48 hours after application. The label states to use incorporation equipment capable of thoroughly and uniformly mixing Sonalan® 10G into the top 2 to 3 inches of the final seedbed. Optional Methods of incorporation for soybeans, dry beans and peanuts on medium and coarse textured soils. Sonalan® l0G may be applied as a surface application and incorporated by rainfall or sprinkler irrigation.
****** Potatoes: for use in the States of AZ, CO, NE (West of Rt. 281), 10, KS (West of Rt. 281), MT, ND (West of Rt. 281), NV, NM, OK (West of Rt. 281/283), OR, SD (West of Rt. 281), TX (West of Rt. 281 and Northwest of Rt. 377), UT, WA and WY.
NA = Not applicable (no variation of rates with soil texture classification specified).

FOOTNOTES:
If local need or geographically restricted label- States / regions where usage is currently permitted are listed in parenthesis or in a footnote.
[2] Maximum crop cycle / seasonal / annual application rates are generally not explicitly specified on the product labels. A maximum number of applications (1 in all cases where specified) per season is sporadically specified with the uses on cucumber, melon, pumpkin, safflower, winter and summer squash. With the granular formulation the following limits are specified:
Safflower = 1.15 lb ai / year.
All other crops on Granular label (canola, crambe, dry beans, dry peas, peanuts, soybeans, and sunflowers) = 1.4 lb ai / year.
Presumably (but not explicitly specified on the label) in situations where a higher single application rate is specified (*e.g.*, for dry beans and sunflowers) this takes precedence over the 1.4 lb ai / year limitation.
[3] C = coarse textured soils, M = medium textured soils, and F = fine textured soils

GENERAL NOTES:
If local need or geographically restricted label- States / regions where usage is currently permitted are listed in parenthesis or in a footnote.
Maximum crop cycle / seasonal / annual application rates are generally not explicitly specified on the product labels. A maximum number of applications (1 in all cases where specified) per season is sporadically specified with the uses on cucumber, melon, pumpkin, safflower, winter and summer squash. With the granular formulation the following limits are specified:
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Presumably (but not explicitly specified on the label) in situations where a higher single application rate is specified (*e.g.*, for dry beans and sunflowers) this takes precedence over the 1.4 lb ai / year limitation.

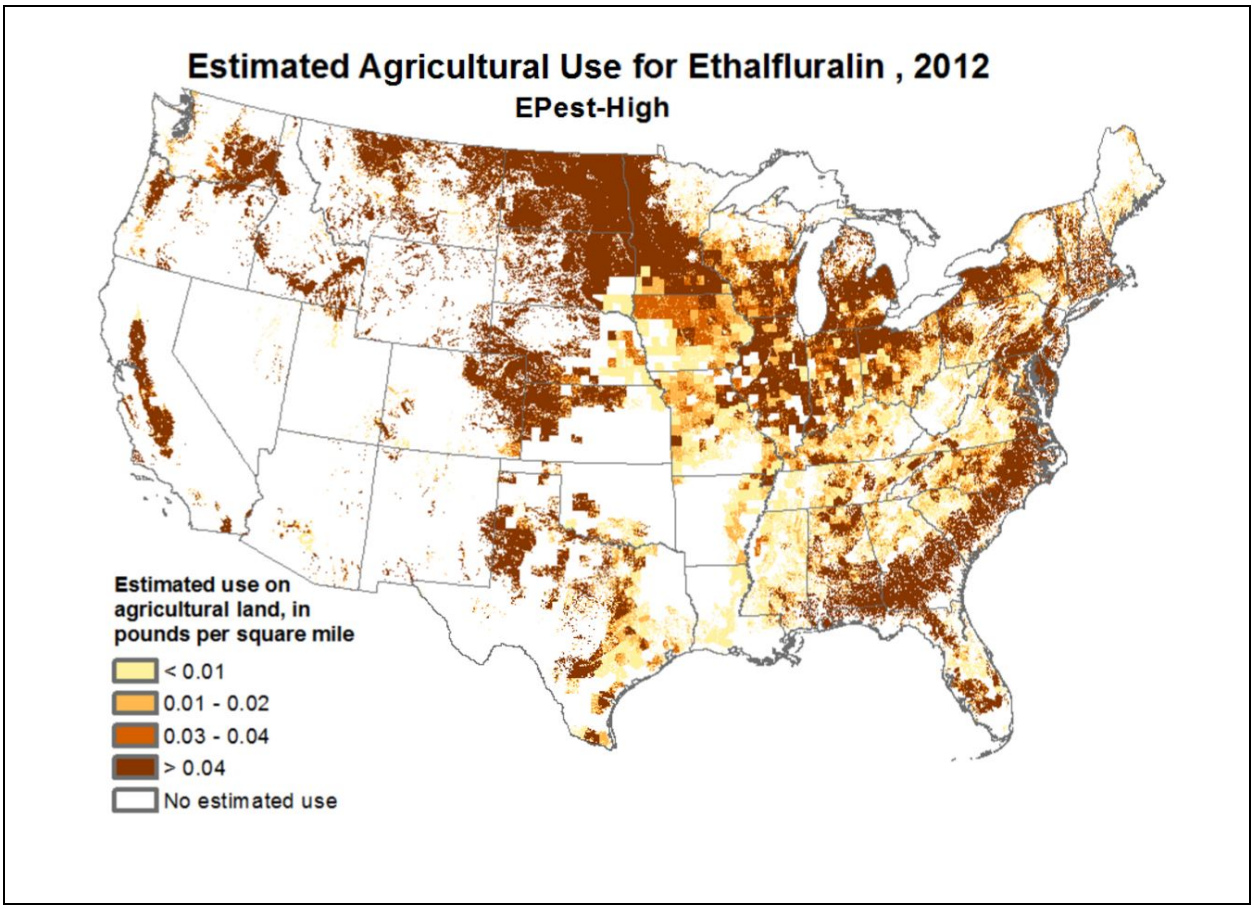
3.2 Usage

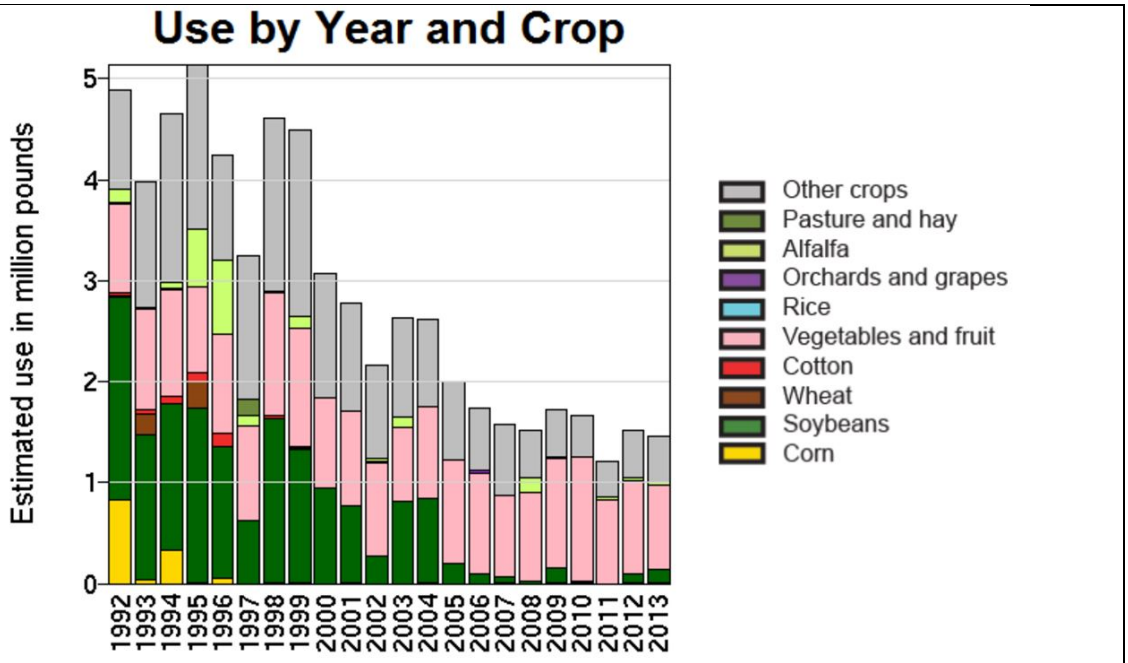
In recent years, the use sites with ten percent or more of the crop treated (estimated) have been: cucumbers, pumpkins, squash, dry beans/peas, peanuts, watermelons, and sunflowers according to the screening-level use assessment (SLUA) provided by BEAD (see Table 3).The largest uses in terms of the estimated annual acres treated have been dry beans/peas followed by peanuts and sunflowers.

Overall, the usage of ethalfluralin has been declining since 2002, according to estimates provided by the U.S. Geological Survey (see Figure 1). The most recent year estimate (using the "EPest High" method the USGS considers the most conservative for calculating usage) in 2013 was about 1.5 million pounds applied nationally.

Table 3. Screening Level Estimates of Agricultural Uses of Ethalfluralin for 2004-2013.

Crops	Average Annual Lbs. A.I. Applied	Percent Crop Treated	
		Average Annual	Maximum
Alfalfa	9,000	<1	<2.5
Beans, Green+	6,000	5	25
Cabbage+	<500	<1	<2.5
Canola	4,000	<2.5	<2.5
Cantaloupes	5,000	5	15
Cucumbers	50,000	50	65
Dry Beans/Peas	600,000	25	40
Peanuts	200,000	25	40
Peas, Green+	<500	<1	<2.5
Peppers+	<500	<1	<2.5
Potatoes	2,000	<1	<2.5
Pumpkins	20,000	30	40
Soybeans	40,000	<1	<2.5
Squash	10,000	30	35
Sunflowers	200,000	10	20
Watermelons	20,000	20	35
TOTAL	ca. 1,168, 000		
(BEAD estimates, 6/11/2015; based on data sources reflecting usage over the period 2004 - 2013)			


Estimated Agricultural Use for Ethalfluralin , 2012
EPest-High
Estimated use on agricultural land, in pounds per square mile
< 0.01
0.01 - 0.02
0.03 - 0.04
> 0.04
No estimated use



"Use by Year and Crop" bar chart note: Order of crops in bars from top to bottom is: Other crops, pasture and hay, alfalfa, orchards and grapes, rice, vegetables and fruit, cotton, wheat, soybeans, and corn.

Source:
https://water.usgs.gov/nawqa/pnsp/usage/maps/index.php.
Specific url:
https://water.usgs.gov/nawqa/pnsp/usage/maps/show_map.php?year=2012&map=ETHALFLURALIN&hilo=H

Figure 1. USGS estimate agricultural use for ethalfluralin in the US 2012 map (top figure) and 1992-2013 national summary (bottom figure).

4. Exposure Characterization

4.1 Environmental Fate and Transport Summary

This environmental fate and transport section addresses the environmental fate and transport properties of parent ethalfluralin. This assessment does not consider the environmental fate and transport properties of any of the numerous minor degradates formed from ethalfluralin degradation in the soil through microbial activity (further discussed below).

Ethalfluralin can be characterized as having low to moderate persistence varying with the environmental conditions and dominant transformation pathways pertaining to those conditions. The environmental persistence varies from hours to months depending upon the transformation pathways that are available after application (always incorporated for all uses). Most of the chemical in the soil system will be transformed within 2 months based on the aerobic soil

biotransformation with half-lives ranging from 17 to 46 days. Ethalfluralin transformation is relatively rapid with an anaerobic aquatic half-life of 1.6 days (single test). If sunlight is present ethalfluralin transformation can be quite rapid (aquatic photodegradation half-life value of 6.3 hours). This may greatly accelerate the degradation of any dissolved residues present in clear surface waters but the effect of photolysis on most aquatic systems is not expected to be significant due to turbidity and light attenuation in most water bodies. Ethalfluralin is practically insoluble in water and is strongly bound to soil and sediment so the extent to which it is dissolved in the water column and susceptible to photolysis is likely limited.

Ethalfluralin has a vapor pressure of 8.2×10^{-5} mm Hg at 25°C which is indicative of a potential for significant dissipation in the environment by volatilization (Kennedy and Talbert, 1977). 1977).Vapor-phase ethalfluralin is expected to degrade in the atmosphere by reaction with photo-chemically produced hydroxyl radicals and ozone molecules. The half-life for this reaction in air with hydroxyl radicals is estimated to be 6 hours and the half-life for this reaction with ozone is estimated as 23 hours.[1] With the EPI (Estimation Programs Interface) Suite[2] AOPWIN function the hydroxyl radical reaction half-life was estimated to be 1.9 hours and ozone reaction half-life was estimated to be 22.9 hours. Therefore, chronic atmospheric exposure, or transport are precluded, and any concerns would likely be restricted to acute exposures. Ethalfluralin's potential for volatilization may be reduced significantly because it adsorbs strongly to soils as well as to suspended solids, particulate, sediment, and organic matter in the water column.

Ethalfluralin will be mostly immobile in soil and bound to sediment in both terrestrial and aquatic environments (Freundlich K_{ads} values of 12 to 97 mg/L, K_{foc} values of 3957 to 8361 ml/g). While ethalfluralin is not expected to contaminate ground water, it may reach ground water through its binding capacity to soil and soil particles and through erosion (*i.e.*, runoff of sediment-bound residues), and a very limited number of low level detections have been reported in ground water where ethalfluralin was included as an analyte. In surface waters, ethalfluralin is likely to be quickly and predominantly partitioned to sediments, however no monitoring data are available for sediments. Ethalfluralin would be likely though be quickly degraded to less toxic compounds which would be tightly bound to sediment colloids and organic material.

Ethalfluralin is stable to hydrolysis at pH values of 3, 6, and 9. Ethalfluralin, based on laboratory studies, is expected to be largely bound to soil particles and subject to aerobic or anaerobic metabolism. Field dissipation half-lives ranged from 23 to 51 days and are similar to the laboratory metabolism half-lives in aerobic soil. No degradates were analyzed for in any of these studies since there were no major degradates in the environmental fate studies.

Adsorption is the highest in soils that are very rich in organic matter or clay content. Higher application rates are recommended on the product labels for these types of soils are consistent with the more rapid loss of available active ethalfluralin parent.

[1] See MRID 00094810 and http://toxnet.nlm.nih.gov/cgi-bin/sis/search/a?dbs+hsdb:@term+@DOCNO+7545 (accessed on 1/10/2011).
[2] Version 4.0, available at: http://www.epa.gov/oppt/exposure/pubs/episuitedl.htm .

Both the aerobic and anaerobic degradation of ethalfluralin is complex with multiple pathways and products, none of which have been found to substantially accumulate in the environment. Several minor (all were <10% of applied, usually much less) metabolites in soil have been detected in the laboratory studies[3]. Ethalfluralin is very similar structurally to trifluralin (a,a,a-trifluoro-2,6-dinitro-N,N-dipropyl-p-toluidine) with the only difference in the molecules being in the nature of the alkyl substitutions of the amine moiety (N-(2-melhyl-2-propenyl) for ethalfluralin versus N,N-dipropyl for trifluralin. For the similar pesticide trifluralin, a very complex degradation pattern has been established involving numerous minor degradation products[4].

See Appendix H for a summary of the ethalfluralin degradation pathway in aerobic and anaerobic soil). For example, in an aerobic metabolism study in three test soils ethalfluralin degraded almost entirely to a multitude of minor degradation products in three test soils (MRID 48915601; study classified as supplemental). The most significant degradates detected in terms of the maximum percent of applied were:

M2 (ET-20) = 2,6-Dinitro-4-(trifluoromethyl)phenol (Up to 5.2% of applied ethalfluralin)
M5 (ET-15M) = 2-Methyl-7-nitro-5-(trifluoromethyl)benzimidazole (Up to 6.5% of applied ethalfluralin)

Unextracted residues increased over time to 51 to 65% in the 3 test soils, but the extraction scheme was sufficient to demonstrate that these residues were readily available and the corresponding accumulation of degradation products was indicative of extensive transformation of parent trifluralin with the accumulation of such residues.

ET-4 = N2-Ethyl-N2-(2-methyl-2-propenyl)-3-nitro-5- (trifluoromethyl)-1,2-benzenediamine
ET-7 = N^2-Ethyl-N^2-(2-methyl-2-propenyl-5-(trifluoromethyl)-1,2,3-benzenetriamine

In an anaerobic soil metabolism study (MRID 42930102) two major metabolites of ethalfluralin, formed by the reduction of one nitro group (ET -4) or both nitro groups (ET-7), were identified during the study: ET-4 reached a maximum of 31.0% of the applied radiocarbon or 0.04 ppm in the day 0 samples, but was not detectable after day 1. ET-7 reached a maximum of 32.0% of the applied radiocarbon at Day 1, but was not detectable after day 1. These are not considered to be major metabolites because they form almost instantly under anaerobic conditions and further transformation takes place rapidly. Multiple strong extraction systems failed to remove most of the applied radioactivity with time – at study conclusion after 6 months of incubation 86 to 94% of the applied radioactivity remained bound to the soil.

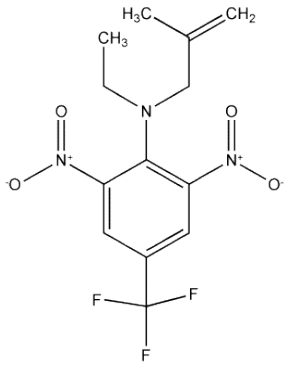
Ethalfluralin has some characteristics which indicate it should be considered for bioaccumulation potential, such as a relatively high log octanol-water partition coefficient (log K_{ow}) of 5.11 and significant bioaccumulation in fish; however, the compound is also subject to relatively rapid depuration half-life of 3 days (**Table 3**). In a study with radio-labeled ethalfluralin, bluegill

[3] In the aerobic metabolism study all degradates were present at 3% or less during the entire course of the 9-month study. See Appendix for structures of the metabolites and a degradation pathway proposed by the registrant.
[4] Grover, R.; Wolt, J.D.; Cessna, A.J; Schiefer H.B. 1997. Environmental fate of trifluralin. Rev Environ Contam Toxicol. 153:1-64.

sunfish (*Lepomis macrochirus*) had measured bioconcentration factors (BCF) ranging from 1040 to 1560X; however, when exposure stopped, half of the compound was depurated after 3 days (MRID 41994902).

In the Environmental Fate and Ecological Risk Assessment Problem Formulation in Support of Registration Review of Ethalfluralin (DP Barcode D382172, 3/14/2011) and the Reregistration Eligibility Decision (RED) document (EPA 738-R-95-001, March 1995) the only residue of concern in animals and plants was determined to be the parent ethalfluralin. However, the RED recommended an additional study of cucurbits to verify whether the parent alone should be considered in setting tolerances.

Table 4. Summary of Physicochemical Properties of Ethalfluralin.

Parameter	Value and Unit	Source
Chemical Structure		
*Chemical N*ame	N-ethyl-∀∀∀-trifluoro-N-(2-methylallyl)-2,6-dinitro-p-toluidine **OR** N-ethyl-N-(2-melhyl-2-propenyl)-2,6-dinitro-4-{trifluoromethyl)benzenamine .	
Smiles Code	CCN(CC(=C)C)C1=C(C=C(C=C1[N+](=O)[O-])C(F)(F)F)[N+](=O)[O-]	
CAS Number	5528-68-6	
PC Code	113101	
Empirical Formula	$C_{13}H_{14}F_3N_3O_4$	Product Chemistry data
Molecular Weight	333.27 g	Product Chemistry data
Appearance	crystalline	Product Chemistry data
Color	Yellow	Product Chemistry data
Odor	faint amine-odor	Product Chemistry data
Melting Point	57 – 59 ºC	Product Chemistry data
Vapor pressure (25ºC)	8.2×10^{-5} mm Hg (torr)	Product Chemistry data
Water Solubility (pH 7, 20ºC)	0.3 mg/L	Product Chemistry data
Henry's law constant (K_H)	1.2×10^{-4} atm M^3/mole	Calculated from molecular weight and solubility

Log Octanol/Water Partition Coefficient (log K_{ow}) (22ºC)	5.11	MRID 41890101
Log Octanol/Air Partition Coefficient (log K_{oa})	7.39	Estimated with EPI Suite™ 4.11[a]
Biomagnification Potential	Presumption*: If log K_{OA} >5, log K_{OW} >2 and the rate of chemical transformation is low, the chemical may bio-magnify in terrestrial food chains►	► Gobas *et al.* 2003 and Armitage & Gobas, 2007 [5] support this presumption utilized here only as a broad reference to determine the potential for biomagnification in terrestrial food webs and is based on slowly-metabolized chemicals.
	For ethalfluralin, the log K_{OW}=5.11 easily meeting the criterion, but the rate of transformation in tissues of biota is relatively fast. Therefore it cannot be confirmed that ethalfluralin has a potential to bio-magnify in terrestrial food chains. In fish, ethalfluralin did bioaccumulate (BCF range: 1040 – 1560X) but also rapidly depurated with a depuration half-life of 3 days, which suggests it may be metabolized in fish and excreted (MRID 41994902).	
[a] http://www.epa.gov/tsca-screening-tools/download-epi-suitetm-estimation-program-interface-v411		

Summary of Fate Properties of Ethalfluralin.

PROPERTY	VALUE	DATA SOURCE	COMMENTS
Hydrolysis	Stable at pH 3,6, and 9	MRID # 000948-05	
Henry's Law Constant	1.2 x 10^{-4} atm M^3/mol	One-Liner	Calculated value
Aqueous Photolysis half-life (days)	0.263	MRID 41613916	$t_{½}$ = 6.3 hours
Soil Photolysis half-life (days)	14.2	MRID 41613917	There was increased volatilization of ^{14}C residues in dark vs. irradiated soil, study is supplemental.
Aerobic Soil Metabolism half-life (days), 25 ºC	42.9 17.4 33.6 19.0 95% Upper C.I. mean = 48.5 days	MRID 41613918 MRID 48915601	Half-lives were normalized to 25 ºC (*e.g.*, MRID 48915601 study conducted at 20 ºC.)
Anaerobic Soil Metabolism half-life (days)	13.8	MRID 41613919	
Aerobic Aquatic Metabolism half-life (days)	No study submitted		Previously waived; but at this time it is believed a study could add value to the environmental fate knowledge base for ethalfluralin.

[5] Gobas, F.A.P.C., B.C. Kelly and J.A. Arnot. 2003. Quantitative structure activity relationships for predicting the bioaccumulation of POPs in terrestrial food webs. QSAR Comb. Sci. 22:329-336.

Anaerobic Aquatic Metabolism half-life (days)	1.58	MRID 42930102	
Freundlich Adsorption Coefficient (K_f)	Nueces Sand, 0.5% O.M.: **11.9** (1/n = 0.956) Fox Sandy Loam, 1.4% O.M.: **32.6** (1/n = 0.954) Crosby Loam, 1.8% O.M.: **53.**0 (1/n = 0.963) Brookston Clay Loam, 2.0% O.M.: **97.0** (1/n = 0.986)	MRID 42437202	K_{oc} values not calculated in study.
Organic Matter Partitioning Coefficient (K_{oc})	3,957 ml/g Range: 3957 to 8361 (K_{foc})	MRID 42437202	Additional data also available from European study for 4 soils[6]
Terrestrial Field Dissipation half-life (days), field conditions	23 (silty clay loam, IL) 28 (sandy loam, GA) 51 (loam, CA)	MRID: 41978101 00094819 41441401 41613920 41978101	
Fish Accumulation (BCF); concentration in tissue to exposure concentration in water: 1330X for whole fish, 1560X for muscle, and 1040X for the remainder	(Wet weight). Depuration was rapid with a removal half-life of 3 days after exposure ceased,	MRID 41994902	

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4.2 Exposure Pathways

Ethalfluralin parent compound is considered to be the primary stressors for aquatic and terrestrial organisms in this risk assessment. Ethalfluralin degrades in soils and aquatic systems into minor degradation products (<6% each) and exposure to these degradation products may be considered minimal. There is also evidence of significantly lower phytotoxicity of degradation products[7].

[6] Additional data from European Union dossier Koc range 3967-8083 mL/g. See: http://sitem.herts.ac.uk/aeru/footprint/en/Reports/271.htm .

[7] James, E.H.,, M.S. Kemp and S.R. Moss2 1995. Phytotoxicity of trifluoromethyl- and methyl-substituted dinitroaniline herbicides on resistant and susceptible populations of black-grass (Alopecurus myosuroides). Pesticide Science 43:273–277.

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The following description of exposure pathways therefore places emphasis on the environmental fate of and exposure to parent ethalfluralin.

In surface waters, ethalfluralin is likely to be quickly and predominantly partitioned to sediments, however, the available monitoring studies all focus on dissolved concentrations of ethalfluralin.

Adsorption is the highest in soils that are very rich in organic matter or clay content and absorbed herbicide activity is very high. Therefore, higher application rates that are recommended on the product labels for these types of soils are consistent with the more rapid loss of available active ethalfluralin.

Aquatic Exposure

Although ethalfluralin is not particularly mobile, it has potential to be transported to water bodies and aquatic habitats in both a dissolved state in runoff or in a sorbed state to erodible soil particles as well as by drift from spray applications. Limnetic organisms (fish, aquatic invertebrates and plants) which occupy the water column may be exposed to ethalfluralin. Exposure is also expected to occur for benthic and sediment-dwelling organisms given that ethalfluralin readily partitions to sediment and organic matter given its measured K_{oc} in the range between 3957 and 836l mL/g.

The low to moderate persistence and strong sorption capacity of ethalfluralin in the environment lends itself to being available to runoff primarily via the process of erosion. This process is likely to be more significant if rain occurs shortly after application. Furthermore, off-site spray drift deposition of ethalfluralin to water bodies nearby applications may also result in exposure of aquatic organisms.

Terrestrial Exposure

- **Dietary Exposure**: Direct dietary exposure to non-target terrestrial organisms (birds and mammals) is possible with the application of ethalfluralin. Ethalfluralin is applied prior to and post emergence of crops; insectivores and granivores may ingest food items possessing the ethalfluralin residues. Dietary exposure is also possible given the moderate persistence of ethalfluralin in the terrestrial environment.

  Furthermore, indirect dietary exposure may result from aquatic exposure to fish (discussed above). Therefore, piscivorous birds and mammals feeding on contaminated fish may potentially be exposed. Bioaccumulation potential of ethalfluralin residues is possible in fish given ethalfluralin's high Log K_{ow} value of 5.11. There is uncertainty in this route of exposure since there is relatively rapid metabolism/depuration in fish.

- **Terrestrial plants:** Exposure may occur via the runoff of residues off-site from treated fields to adjacent lands covered with non-targeted vegetation. Furthermore, off-site deposition of ethalfluralin due to spray drift may also occur.

- **Terrestrial invertebrates:** Dietary and contact exposure for terrestrial invertebrates are possible pathways with ethalfluralin applications.

4.3 Aquatic Exposure Analysis

Aquatic Exposure Estimation Modeling

Estimated exposure concentrations for aquatic animals and plants in surface waters for labeled ethalfluralin applications are estimated using The Surface Water Concentration Calculator interface (SWCC; version 1.106; dated May 22, 2014). The SWCC is available on-line at: http://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/models-pesticide-risk-assessment. Primarily to test the predicted impact of simulation of volatilization on the exposure estimate, limited additional model runs were made with a replacement version of this model that was not officially adopted by EFED at the time of this assessment (the Pesticide Water Calculator), this can reduce the calculated EECs by up to 5% for ethalfluralin.

In this assessment, exposure estimates for each of the current uses represent the highest and most vulnerable exposure for ethalfluralin use sites across the country. For all of the agricultural crop uses, broadcast surface spray applications to bare ground with very shallow incorporation is evaluated since this is the conservative application scenario for runoff. For the FL cucumber scenario (which yielded the highest EECs of any modeled scenario) this assumption increases acute and chronic EEC estimates by 25 to 30% versus assuming a uniform incorporation to a 4 cm depth (See Appendix C.) However, estimated environmental concentrations (EECs) in the water column for aquatic habitat are mostly dominated by spray drift deposition directly in the receiving water body. The fate parameters and use-specific input parameters for the SWCC surface water modeling are shown in **Table 5** and **Table 6,** respectively. The EECs of ethalfluralin in surface water are summarized in **Table 7**. A more detailed EEC summary and selected SWCC input / output files are provided in **Appendix C.** Model inputs were selected following the input parameter guidance found here: https://www.epa.gov/pesticide-science-and-assessing-pesticide-risks/guidance-selecting-input-parameters-modeling .

Table 5. **Ethalfluralin physicochemical and fate property** inputs for the SWCC model.

PROPERTY	VALUE	DATA SOURCE	COMMENTS
Molecular Weight	333.27	Product Chemistry	
Hydrolysis	Stable	MRID # 000948-05	
Water Solubility (pH 7, 20 ºC)	0.3 mg/L	Product Chemistry data	Water Solubility (pH 7, 20oC)
Vapor pressure (25 ºC)	8.2 x 10^{-5} mm Hg	Product Chemistry data	Vapor pressure (25 C)

Aerobic Soil Metabolism half-life (days), 25 ºC	95% Upper C.I. mean = 48.5 days	MRID 41613918 MRID 48915601	Half-lives were normalized to 25 ºC (*e.g.*, MRID 48915601 study conducted at 20 ºC.) 95% C.I. due to uncertainty regarding identification of all residues.
Aerobic Aquatic Metabolism half-life (days)	97		2 X the aerobic soil metabolism half-life input (per guidance when direct data are not available.)
Anaerobic Aquatic Metabolism half-life (days)	1.58	MRID 42930102	
Organic Matter Partitioning Coefficient (K_{foc})	3957 ml/g	MRID 42437202	K_{oc} value for sandy loam; lowest value among 4 soils[8], used to provide a conservative estimate of runoff.

Table 6. SWCC crop scenario and application-related input parameter values for ethalfluralin aquatic exposure estimation.

Use Represented	Scenario IDs	Application dates (for separate simulations	# of applications / year	Application rate (kg ai /ha)
Soybeans	IL Corn STD KS Corn Std MS corn STD MS soybean STD NC corn STD OH Corn STD PA corn STD	June 10 June 25 October 10 October 25	1	1.47
Sunflower (conservative for other oilseed crops)	ND Canola Std KS corn Std	15-May 10-Jun 10-Oct 25-Oct	1	1.91
Cucurbits	FL Cucumber Std	October 15 October 30	1	1.91
Peanuts	NC Peanut std	October 10	1	1.29
Dry Beans (conservative for lentils)	MI Dry beans Std	October 25	1	1.89
Potatoes	ID New Potato Std	May 10	1	1.15
Alfalfa, Clover (conservative for dill)	CA Alfalfa Std	January 10	1	1.89

[8] European Union dossier Koc range 3967-8083 mL/g. See: http://sitem.herts.ac.uk/aeru/footprint/en/Reports/271.htm .

[6]Spray drift fraction for aerial and ground applications from Table 2 of EPA, 2013, "Guidance on Modeling Offsite Deposition of Pesticides via Spray Drift".

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The maximum aquatic EECs (peak, 21-day and 60-day) by crop based on the SWCC farm pond scenario are summarized in **Table 7** (representing multiple scenarios and application dates tested, full results are provided in **Appendix C**. Benthic sediment concentrations were also estimated with the peak and 21-day concentrations of 77.6 µg a.i. /L (parts per billion of dry sediment; ppb) and 52.8 ppb, respectively.

Table 7. SWCC estimated upper-bound peak, 21-day and 60-day concentrations in the surface water column and sediment for ethalfluralin at the highest application rate for proposed crop uses.

Crop Represented (Scenario ID)	Concentration µg/L			
	Applicat. Date	Peak	21-day	60-day
Soybeans (MS Corn)	**Oct. 10**	**6.51**	**2.6**	**---**
Soybeans (MS Corn)	**Oct. 25**	---	---	1.36
Sunflower+ (KS Corn)	**Jun. 10**	7.69	2.92	1.2
Cucurbits (FL Cucumber)	**Oct. 30**	**12.5**	**3.55**	**1.36**
Peanut (NC Peanut)	**May 1**	4.12	1.37	0.57
Dry Beans (MI Beans)	**May 15**	5.9	1.69	0.71
Potatoes (ID New Potato)	**May 10**	5.9	1.69	0.71
Alfalfa and Clover (CA Alfalfa OP)	**Jan. 10**	5.81	2.09	0.96

Water Quality Monitoring Data

Due to its low overall usage profile and relatively low propensity to remain in the dissolved phase in surface waters, there are relatively few detections of ethalfluralin almost all at sub ppb levels for surface waters and sub ppt levels for groundwater. These data are provided for perspective, but the monitoring data are largely not associated with ethalfluralin usage profiles to facilitate an understanding of the loadings associated with the monitoring data. These data cannot

be verified to provide an indication of the maximum aquatic exposure potential or the usage pattern associated with relatively high levels in water. In addition, monitoring for ethalfluralin does not provide a complete picture of ecological exposure potential because of the lack of monitoring associated with dissolved organic material or sediment.

Combined Water Quality Portal Data

A search of the National Water Quality Monitoring Council's Water Quality Portal (WQP[9]) was conducted on 1/21/2016. The WQP includes data collected by over 400 state, federal, tribal, and local agencies along with large previously separate databases associated with STORET, USGS National Water Quality Monitoring Program (NAWQA) and other important monitoring sources. Out of a total of 31,637 samples (both surface and groundwater) analyzed for ethalfluralin there were 185 detections of ethalfluralin at concentrations between 0.01 and 0.768 ppb; there 3 detections above 0.1 ppb. Since none of these data verified a potential for ethalfluralin to occur in surface waters at concentrations greater than modeled, further detailed investigation of the nature of the available monitoring data was not conducted for this assessment.

USDA Pesticide Data Program

Drinking water monitoring data collected by USDA's Pesticide Data Program (PDP) are available for ethalfluralin for the years 2003 to 2014. During this time period, a total of 1,253 water samples were collected none of which contained detectable residues of ethalfluralin.

NAWQA Surface Water Monitoring

The USGS NAWQA[10] data warehouse was searched on 12/23/2010 (the NAWQA data are now included in the WQP for which an updated search including NAWQA was conducted on 1/21/2016.). Ethalfluralin was detected at concentrations between 0.005 and 0.768 ug/L (ppb) in 190 of 22,876 surface water samples (0.83% detection frequency) collected across the United States[11]. The detection rate was higher in older samples - 1.49% out of 2,006 stream water samples collected from 1992 to 2001 with a minimum detection limit of 0.005 ppb or less for all samples analyzed; the higher rate could be because of higher use of ethalfluralin in the earlier time period and/or be due to differences in study area concentrations over the years.

The highest number of detections of ethalfluralin occurred in the following states (with 5 or more detections):

- 113 in California
- 39 in Washington
- 16 in Colorado
- 15 in Idaho

[9] WQP is a cooperative service cosponsored by the United States Geological Survey (USGS) and the Environmental Protection Agency (EPA),

[10] http://infotrek.er.usgs.gov/nawqa_queries/swmaster/index.jsp (visited December 23, 2010)

[11] The NAWQA long-term monitoring program has focus areas across the US that change over time. There were an additional 26 detections below 5 ppt, but levels below 5 ppt would be undetectable if present in most samples because the practical minimum detection limit was at or near 5 ppt in most cases.

- 9 in North Dakota

There was a definite geographic concentration of the detections with the following watersheds /sites having the highest rate of detections:

(1.) 77 detections at ORESTIMBA CR AT RIVER RD NR CROWS LANDING CA (Stanislaus Co., CA)
(2.) 17 detections at SAN JOAQUIN R NR VERNALIS CA (San Joaquin Co., CA)
(3.) 12 detections at ROCK CREEK AB HWY 30/93 XING AT TWIN FALLS ID (Twin Falls Co., ID)
(4.) 11 detections at LONETREE CREEK NEAR GREELEY CO. (Weld Co., Colorado)

NAWQA Ground-Water Monitoring

The USGS NAWQA data warehouse was searched on 12/23/2010 (also updated in a WQP search on 1/21/2016). Ethalfluralin was detected at concentrations between 0.005 and 0.090 ppb in 3 of 8,528 ground-water samples (0.035% detection frequency) collected across the United States. The sample which contained 0.090 ppb ethalfluralin (from Franklin County, Washington) was the only sample with greater than 0.006 ppb ethalfluralin.

4.4 Clean Water Act

Ethalfluralin is not identified as a cause of impairment for any water bodies listed as impaired under section 303(d) of the Clean Water Act, based on information provided at http://iaspub.epa.gov/waters10/ez_where.retrieval_list .

In addition, no Total Maximum Daily Load (TMDL) has been developed for ethalfluralin, based on information provided at http://iaspub.epa.gov/tmdl_waters10/attains_nation.tmdl_pollutant_detail?p_pollutant_group_id=885&p_pollutant_group_name=PESTICIDES. More information on impaired water bodies and TMDLs can be found at http://www.epa.gov/owow/tmdl/.

4.5 Terrestrial Exposure Analysis

In order to estimate risks of ethalfluralin exposures in terrestrial environments, all exposure modeling and resulting risk conclusions will be based on maximum application rates for a given use. Measures of exposure are based on terrestrial models that predict EECs of ethalfluralin.
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4.5.1 Terrestrial Animal (Birds (surrogates for reptiles and terrestrial-phase amphibians) and Mammals) Dietary Exposure Estimation

Ethalfluralin may be applied as either a ground application using an emulsified concentrate or in granular form which will reduce exposure relative to foliar application. For ground applications of emulsifiable concentrate, birds and mammals may be exposed to pesticide residues after

application through oral or dietary exposure to seeds or insects when foraging in the treated fields for nesting material or food. Therefore estimation of pesticide concentrations in wildlife food items focuses on quantifying possible dietary ingestion of residues on vegetative matter and insects. The EFED terrestrial exposure model T-REX (T-REX, Version 1.5, released 03/2012) is used to estimate exposures and risks to avian and mammalian species. Input values for avian and mammalian toxicity as well as chemical application rates and foliar dissipation half-life data are required to run the model. The model provides estimates of exposure concentrations and risk quotients (RQs). Specifically, the model provides estimates of concentrations (upper-bound and mean) of chemical residues on the surface of different types of foliage and insects that may be dietary sources of exposure to avian, mammalian, reptilian, or terrestrial-phase amphibian receptors. The surface residue concentration (in mg ai/kg; parts per million; ppm) is estimated by multiplying the application rate (pounds active ingredient per acre) by a value specific to each food item. These values (termed the Hoerger-Kenaga estimates) along with a more detailed discussion of the methodology implemented by T-REX, are presented in **Appendix E** (T-REX Model). By comparing EECs to acute and chronic toxicity reference values, RQs are calculated. The EECs on food items may be compared directly with dietary toxicity data or converted to an oral dose. The residue concentration is converted to daily oral dose based on the fraction of body weight consumed daily as estimated through allometric relationships. The screening-level risk assessment for ethalfluralin uses upper-bound predicted residues as the measure of exposure. Consideration is given to different types of feeding strategies, including herbivores, insectivores and granivores. Dose-based exposures are estimated for three weight classes of birds (20 g, 100 g, and 1000 g) and three weight classes of mammals (15 g, 35 g, and 1000 g). Summaries of the predicted upper-bound residues of ethalfluralin that may be expected to occur on selected avian or mammalian food items immediately following application for the maximum use scenario are presented in **Tables 11, 12, and 13.**

4.5.2 Spray Applications

Input values for the endpoints used for estimating avian and mammalian exposure risks to ethalfluralin are summarized in **Table 8.** For spray applications the default value for foliar half-life of 35 days was used for ethalfluralin residues on plants. The application rates and application methods are summarized above in **Table 10** of the uses and consist of both spray applications and granular applications.

Table 8. Input parameters for endpoints used in T-REX v 1.2.5 to determine terrestrial RQs.

Input Parameters	Value	Source
Avian Oral LD_{50}	>2000 mg/kg-bw (zebra finch)	MRID 48915502
Avian Dietary	5000 ppm (bobwhite quail)	Acc. No. 070677

Avian Reproduction NOEAC	1000 ppm (mallard duck)	Acc. No 00094763
Mammal LD_{50}	5000 mg/kg-bw (rat)	Acc. No 00135189
Mammal NOAEC	61 mg/kg-bw (rat)	Acc. No 0094784 and MRID 42300301

For the maximum ethalfluralin application scenario of 1.69 lbs ai/A, concentrations for different avian forage types ranged from 1 to 462 ppm for dose-based upper-bound residues (**Table 9**) and 7 to 164 ppm for mean residues from emulsified concentrate applications. Mammalian dose-based residues ranged from 1 to 387 ppm (**Table 10**). Dietary residue concentrations ranged from and 15 to 406 ppm (**Table 11**). EECs that resulted from granular applications ranged from 1.2 to 2.11 mg ai ft^{-2} (Table 12).

Table 9. Avian TREX upper-bound dose-based EECs (mg/kg)

.	20 g "Small" Bird						100 gram "Medium" Bird						1000 gram "Large" Bird					
Use (application rate lbs a.i./A)	**Short Grass**	**Tall Grass**	**Broadleaf Plants**	**Fruits/pods**	**Arthropods**	**Seeds**	**Short Grass**	**Tall Grass**	**Broadleaf Plants**	**Fruits/pods**	**Arthropods**	**Seeds**	**Short Grass**	**Tall Grass**	**Broadleaf Plants**	**Fruits/pods**	**Arthropods**	**Seeds**
Alfalfa with low broadcast spray (1.698)	462	212	260	29	181	6.4	263	121	148	16	103	3.7	118	54.1	66	7.4	46	1.6
Potatoes chemigation (1.028)	281	129	158	18	110	3.9	160	73	90.1	10	63	2.2	72	32.9	40	4.5	28	1
Sunflower (1.3) granular, incorporated, chemigation	355	163	200	22	139	4.9	203	93	114	13	79	2.8	91	41.6	51	5.7	36	1.3

Table 10. Mammalian TREX dose-based EECs (mg/kg).

	15 gram "Small" Mammal						35 gram "Medium" Mammal						1000 gram "Large" Mammal					
Use (application rate lbs a.i./A)	**Short Grass**	**Tall Grass**	**Broadleaf Plants**	**Fruits/pods**	**Arthropods**	**Seeds**	**Short Grass**	**Tall Grass**	**Broadleaf Plants**	**Fruits/pods**	**Arthropods**	**Seeds**	**Short Grass**	**Tall Grass**	**Broadleaf Plants**	**Fruits/pods**	**Arthropods**	**Seeds**
Alfalfa with low broadcast spray (1.698)	387	177	218	24	151	5	267	122	150	17	105	4	62	28	35	4	24	1
Potatoes chemigation (1.028)	235	108	132	15	92	3	163	75	91	10	64	2	38	17	21	2	15	1
Sunflower (1.3) granular, incorporated, chemigation	297	136	167	19	117	4	206	94	116	13	81	3	48	22	27	3	19	1

Table 11. T-REX dietary based EECs.

Use (application rate lbs a.i./A)	**Short Grass**	**Tall Grass**	**Broadleaf Plants**	**Fruits/pods**	**Arthropods**
Alfalfa with low broadcast spray (1.698)	406	186	228	25	159
Potatoes chemigation (1.028)	247	113	139	15	97
Sunflower (1.3) granular, incorporated, chemigation	312	143	176	20	122

4.5.3 Granular applications

For granular applications of ethalfluralin T-REX (v. 1.5.2; 03/22/2012) is able to calculate the LD_{50} ft^{-2} risk index values for the labeled uses. The assumed incorporation of these methods of application is 85%. Thus 15% of the chemical is assumed to be available for consumption by both avian and mammalian taxa. The LD_{50} ft^{-2} value is calculated using a toxicity value (adjusted LD_{50}) and the EEC (mg a.i. ft^{-2}) and is directly compared with the Agency's levels-of-concern (LOCs). As with EC formulations, consideration is given to different types of feeding strategies including herbivores, insectivores and granivores. Dose-based exposures are estimated for three weight classes of birds (20 g, 100 g, and 1000 g) and three weight classes of mammals (15 g, 35 g, and 1000 g). The EECs that result from granular formulations is presented in **Table 14**.

Table 12. Estimated LD_{50}/ft^2 (in mg active ingredient (a.i.) per square foot) from granular applications of ethalfluralin across uses.

Use (application rate lbs a.i./A)	mg a.i/ft^2
Clover 3" incorporated (1.35)	2.11
Lentils, mustard granular formulation incorporated (0.95)	1.48
Peanuts granular formulation (1.15)	1.8
Peas granular formulation (0.76)	1.2
Safflower granular 1.15)	1.8
Safflower incorporated (1.142)	1.78
Soybeans granular (1.33)	2
Sunflower (1.3) granular, incorporated, chemigation	2

4.5.4 Terrestrial Plant Exposure Estimation

The routes of exposure to terrestrial plants for ethalfluralin include off-site transport via spray drift and runoff. The TerrPlant model (v. 1.2.2; December 26, 2006) evaluates terrestrial plant exposure contributions from runoff and spray drift. It is used to derive EECs relevant to terrestrial and wetland plants. The model employs the assumption that default fractions of the intended application are transported to an adjacent field through runoff and spray drift. There is not any drift assumed for granular applications and more accurate measures of off-site drift is modeled using the AgDrift model. Measures of exposure to terrestrial plants are expressed as a

fraction of the mass of the ethalfluralin applied to the treated field. TerrPlant EECs are shown in **Table 13** below.

Table 13. TerrPlant EECs (lbs. a.i. /A) for ethalfluralin exposure to terrestrial and wetland plants resulting from runoff and spray drift.

Use (application rate - lbs a.i./A)	Description of Area	EEC (lbs a.i/A)
Alfalfa, Beans, Cucurbits with low broadcast spray EC1 (1.698)	Runoff to dry areas	0.017
	Runoff to semi-aquatic areas	0.17
	Spray drift	0.017
	Total for dry areas	0.034
	Total for semi-aquatic areas	0.187
Alfalfa, Beans with chemigation EC3 (1.698)	Runoff to dry areas	0.017
	Runoff to semi-aquatic areas	0.17
	Spray drift	0.085
	Total for dry areas	0.102
	Total for semi-aquatic areas	0.255
Beans granular (1.69)	Runoff to dry areas	0.017
	Runoff to semi-aquatic areas	0.17
	Spray drift	0
	Total for dry areas	0.017
	Total for semi-aquatic areas	0.17
Clover 3" incorporated (1.5)	Runoff to dry areas	0.005
	Runoff to semi-aquatic areas	0.05
	Spray drift	0.015
	Total for dry areas	0.02
	Total for semi-aquatic areas	0.065
Dill ground spray (1.13)	Runoff to dry areas	0.015
	Runoff to semi-aquatic areas	0.15
	Spray drift	0.015
	Total for dry areas	0.03
	Total for semi-aquatic areas	0.165
Lentils, Mustard granular formulation 2" incorporation (0.95)	Runoff to dry areas	0.00475
	Runoff to semi-aquatic areas	0.0475
	Spray drift	0
	Total for dry areas	0.00475
	Total for semi-aquatic areas	0.0475
	Runoff to dry areas	0.0085

Use (application rate - lbs a.i./A)	Description of Area	EEC (lbs a.i/A)
Oilseed-Sunflower, Jojoba, *etc* (1.7) Granular 2 inch incorporation	Runoff to semi-aquatic areas	0.085
	Spray drift	0
	Total for dry areas	0.0085
	Total for semi-aquatic areas	0.085
Oilseed-Sunflower, Jojoba, *etc* (1.7) Granular F 3 inch incorporation	Runoff to dry areas	0.005667
	Runoff to semi-aquatic areas	0.056667
	Spray drift	0
	Total for dry areas	0.005667
	Total for semi-aquatic areas	0.056667
Oilseed-Sunflower, Jojoba, *etc* (1.7) EC3 chemigation	Runoff to dry areas	0.017
	Runoff to semi-aquatic areas	0.17
	Spray drift	0.085
	Total for dry areas	0.102
	Total for semi-aquatic areas	0.255
Oilseed – Crambe, Rapeseed (canola), *etc*. group (0.95) EC2 spray with 2 inch incorporation	Runoff to dry areas	0.00475
	Runoff to semi-aquatic areas	0.0475
	Spray drift	0.0095
	Total for dry areas	0.01425
	Total for semi-aquatic areas	0.057
Oilseed – Crambe, Rapeseed (canola), *etc*. group (0.95) Granular with 2 inch incorporation	Runoff to dry areas	0.00475
	Runoff to semi-aquatic areas	0.0475
	Spray drift	0
	Total for dry areas	0.00475
	Total for semi-aquatic areas	0.0475
Oilseed-Safflower (1.15) granular with 2 inch incorporation	Runoff to dry areas	0.00575
	Runoff to semi-aquatic areas	0.0575
	Spray drift	0
	Total for dry areas	0.00575
	Total for semi-aquatic areas	0.0575
Peanuts granular formulation (1.15) with 2 inch incorporation	Runoff to dry areas	0.00575
	Runoff to semi-aquatic areas	0.0575
	Spray drift	0
	Total for dry areas	0.00575
	Total for semi-aquatic areas	0.0575
Peanuts EC with 2 inch incorporated (1.15)	Runoff to dry areas	0.00575
	Runoff to semi-aquatic areas	0.0575
	Spray drift	0.0115

Use (application rate - lbs a.i./A)	Description of Area	EEC (lbs a.i/A)
	Total for dry areas	0.01725
	Total for semi-aquatic areas	0.069
Peas EC (0.75) 2 inch incorporation	Runoff to dry areas	0.00375
	Runoff to semi-aquatic areas	0.0375
	Spray drift	0.0075
	Total for dry areas	0.01125
	Total for semi-aquatic areas	0.045
Peas granular formulation (0.75) 2 inch incorporation	Runoff to dry areas	0.00375
	Runoff to semi-aquatic areas	0.0375
	Spray drift	0
	Total for dry areas	0.00375
	Total for semi-aquatic areas	0.0375
Potatoes chemigation (1.028)	Runoff to dry areas	0.00514
	Runoff to semi-aquatic areas	0.0514
	Spray drift	0.0514
	Total for dry areas	0.05654
	Total for semi-aquatic areas	0.1028
Potatoes ground (1.028)	Runoff to dry areas	0.00514
	Runoff to semi-aquatic areas	0.0514
	Spray drift	0.01028
	Total for dry areas	0.01542
	Total for semi-aquatic areas	0.06168
Soybeans Granular (1.3) 2 inch incorporation	Runoff to dry areas	0.0065
	Runoff to semi-aquatic areas	0.065
	Spray drift	0
	Total for dry areas	0.0065
	Total for semi-aquatic areas	0.065

4.5.5 Terrestrial Invertebrate Exposure Estimation

Drift from the boom sprayers or residues may come into contact with pollinators either through direct contact or ingestion of residues in pollen/nectar. Possible exposures from either acute contact or oral exposure to the proposed applications rates were calculated using Bee-Rex model (version 1.0). To calculate contact exposure, the application rate was multiplied by 2.7 µg a.i. /bee. Oral exposure was calculated by multiplying the application rate by ((110 µg a.i. /g) * 0.292g/day)). For details see the *Guidance for Assessing Pesticide Risks to Bees* (USEPA,

2014). Estimated dose exposure concentrations for honeybee (*Apis mellifera*) contact and oral exposure are presented in **Table 14** resulting from each representative ethalfluralin uses.

Table 14. Ethalfluralin contact and oral estimated exposure dose concentrations to honeybees.

Use (Application Rate - lbs a.i./A)	Contact Exposure (mg/kg)	Oral Exposure (mg/kg)
Alfalfa with low broadcast spray (1.698)	4.5	54.5
Potatoes chemigation (1.028)	2.8	33
Sunflower (1.3) granular, incorporated, chemigation	3.5	41.8

4.5.6 Picivorous Avian and Mammal exposure to fish containing ethalfluralin residues

The KABAM model (K_{ow} (based) Aquatic BioAccumulation Model; version 1.0) was used to evaluate the potential exposure and risk of direct effects to birds and mammals via bioaccumulation and biomagnification in aquatic food webs. KABAM is used to estimate potential bioaccumulation of hydrophobic organic pesticides in freshwater aquatic ecosystems and risks to mammals and birds consuming aquatic organisms which have bioaccumulated these pesticides. The bioaccumulation portion of KABAM is based upon work by Arnot and Gobas (2004) who parameterized a bioaccumulation model based on polychlorinated biphenyls (PCBs) and some pesticides (*e.g.*, lindane, DDT) in freshwater aquatic ecosystems (Arnot and Gobas, 2004). KABAM relies on a chemical's K_{ow} to estimate uptake and elimination constants through respiration and diet of organisms in different trophic levels. Pesticide tissue residues are calculated for different levels of an aquatic food web. The model then uses pesticide tissue concentrations in aquatic animals to estimate dose- and dietary-based exposures and associated risks to mammals and birds (surrogate for amphibians and reptiles) consuming aquatic organisms. Seven different trophic levels including phytoplankton, zooplankton, benthic invertebrates, filter feeders, small-sized (juvenile) forage fish, medium-sized forage fish, and larger piscivorous fish, are used to represent an aquatic food web. Importantly, chemical metabolism by biota is assumed to be zero in KABAM so modeling will indicate worse case scenarios of exposure. Input scenarios and parameters were chosen to represent the range of exposures from high to low and are presented in **Table 15.** Example output from the bioaccumulation model is provided in **Appendix F**.

Table 15. Input parameters for KABAM model.

Parameter	Input Value	Source
Pesticide Name	Ethalfluralin	
Log K_{OW}	5.11	MRID 41890101
K_{OC}	3957-8391L/kg O.C.	MRID 42437202

Parameter	Input Value	Source
Use patterns	**Acute Concentration in water column(ppb)**	**Acute Concentration in pore water (ppb)**
Cucurbits (1.7 lb a.i./A)	12.5	0.49
Soybean (1.3 lb a.i./A)	6	0.19

Based on KABAM results and no depuration, estimated concentrations of ethalfluralin residues in the tissue of-organisms in the different trophic levels following application on cucurbits range from 72,690 µg/kg to 174,190 µg/kg **(Table 16).** The measured bioconcentration factors (BCF's) in the laboratory were 1330 L/Kg in the whole fish (MRID 41994902) while the KABAM model estimated a BCF for large fish of 6191. This suggests that KABAM may overestimate the bioaccumulation of ethalfluralin and therefore overestimate the risk from consumption of fish from contaminated water bodies. One reason for this discrepancy between measured and predicted values may be that ethalfluralin is able to rapidly depurate in fish tissues (3 days) and the KABAM models assumes no depuration. So while the Kow indicates that ethalfluralin has a strong tendency to bioaccumulate and this is a possible route of exposure, it is likely that the exposure modeled by KABAM represents a worst case scenario.

Table 16. Estimated concentrations of ethalfluralin in ecosystem components.

Ecosystem Component	Total concentration (µg/kg-ww)	Lipid normalized concentration (µg/kg-lipid)	Contribution due to diet (µg/kg-ww)	Contribution due to respiration (µg/kg-ww)
Phytoplankton	72,690	3634482	N/A	72,689.64
Zooplankton	56,920	1897330	2,222.15	54,697.75
Benthic Invertebrates	61,641	2054701	5,607.68	56,033.37
Filter Feeders	40,471	2023530	3,612.90	36,857.70
Small Fish	94,288	2357210	24,355.55	69,932.85
Medium Fish	115,675	2891869	48,653.60	67,021.15
Large Fish	174,190	4354746	107,805.01	66,384.81

5 Ecological Effects Characterization

This section contains the ecological effects characterization for ethalfluralin based upon registrant-submitted toxicity data for the technical grade active ingredient (TGAI; parent ethalfluralin) and for specified formulations. Ethalfluralin is characterized as being very highly toxic to freshwater and estuarine/marine fish, aquatic-phase amphibians (for which freshwater fish serve as surrogates), and to freshwater invertebrates on an acute exposure basis. The compound is highly toxic to estuarine/marine invertebrates on an acute exposure basis. Chronic exposure resulted in

reductions in growth in fish and freshwater invertebrates and reduced reproduction in estuarine/marine invertebrates.

5.5 Aquatic Effects Summary

The effects of exposure to ethalfluralin on aquatic organisms were determined by assessing freshwater and estuarine/marine taxa. The most sensitive species that are used to assess risk in this assessment are listed in **Table 18**. Additionally, five chronic animal toxicity studies and one aquatic vascular plant toxicity study were submitted since the last assessment:

1) a chronic toxicity test with the sheepshead minnow (*Cyprinodon variegatus*; MRID 48689101);
2) a chronic toxicity test with the freshwater daphnid (*Daphnia magna*; MRID 49086902);
3) a chronic toxicity test with the estuarine mysid shrimp (*Americamysis bahia*; MRID 49037801);
4) a 10-day toxicity tests with the freshwater benthic invertebrate midge *Chironomus dilutus* (MRID 48975701);
5) a 10-day toxicity tests with the freshwater benthic invertebrate amphipod (*Hyalella azteca;* MRID 48975702); and,
6) a toxicity test with the vascular aquatic plant duckweed (*Lemna gibba*; MIRD 49086901).

These studies are marked in bold in **Table 17** of the aquatic taxa endpoints. Only descriptions of these studies are provided below. Refer to previous assessments, (DP# D205884, D296985, and D296987) for more comprehensive descriptions of the studies that are not included here.

Chronic Toxicity to Sheepshead minnow *(Cyprinodon variegatus*) (MRID 48689101)

The 33-day chronic toxicity of ethalfluralin to the early life-stage (ELS) of estuarine/marine sheepshead minnow was studied under flow-through conditions (MRID 48689101). The overall NOAEC and LOAEC was 1.2 and 2.7 µg ai/L respectively, based upon the 4% reduction in total length at the 2.7 µg ai/L levels. This study is classified as scientifically sound and satisfies the guideline requirements for an early life stage toxicity study with fish.

Chronic Toxicity to the Freshwater Invertebrate (*Daphnia magna*) (MRID 49086902)

The 21-day-chronic toxicity of ethalfluralin to *Daphnia* was studied under flow-through conditions (MRID 49086902). The NOAEC and LOAEC were 71 and 150 µg ai/L, respectively, based upon a treatment-related reduction in both total body length (2% decrease) and dry weight (13% decrease) at the 150 µg ai/L level.

Chronic Toxicity to the Saltwater Mysid (*Americamysis bahia)* (MRID 48936801)

A 28-day life cycle toxicity test of ethalfluralin to mysids was studied under flow-through conditions (MRID 48936801). The NOAEC and LOAEC were 29.1 and 57.8 µg a.i. /L

respectively based on a 32.4% reduction in young produced per female. This study is classified as acceptable.

Chronic Toxicity to the Midge (*Chironomus dilutus*) (MRID 48915701)

A 10-day chronic toxicity test of ethalfluralin (MRID 48915701) was performed with the freshwater benthic invertebrate midge using spiked sediment. No treatment-related effects were observed on survival or growth following 10 days of exposure. The NOAEC and LOAEC for the endpoints normalized to organic carbon were 4800 and >4800 mg ai/kg total organic carbon (TOC) or 270 µg a.i. /L and >270 µg a.i. /L for pore water. This study was classified as acceptable.

Chronic Toxicity to the Freshwater Amphipod (*Hyalella azteca*) (MRID 48915702)

A 10-day chronic toxicity test of ethalfluralin *(*MRID 48915702) was performed with the freshwater benthic invertebrate amphipod using spiked sediment. Using mean-measured concentrations, the NOAEC and LOAEC for growth were 10 and 19 mg ai/kg (92 and 140 µg a.i. /L pore water), respectively, based on a 20% reduction in dry weight. The OC-normalized mean measured sediment concentration NOAEC and LOAEC endpoints are 480 and 900 mg ai/kg TOC respectively.

Acute Toxicity of Ethalfluralin to Aquatic Vascular Plants (*Lemna gibba*) (MRID 49086901)

In a 7- day acute toxicity study, the freshwater duckweed was exposed to ethalfluralin under static renewal conditions (MRID 49086901). The initial mean measured concentrations were 0 (negative and solvent controls), 0.36, 1.7, 5.2, 18, 70, and 220 µg ai/L. The NOAEC value based on reductions in frond number yield and frond number growth rate was 1.7 µg ai/L and based on final biomass and biomass growth rate was 5.2 µg ai/L. The EC_{50}/IC_{50} values based on frond number yield, frond number growth rate, final biomass, and biomass growth rate were 7.322, 29.1, 36.77, and >220 µg ai/L, respectively, in terms of initial measured concentrations.

Table 17. Summary of Acute and Chronic Toxicity Data for Aquatic Taxa Exposed to Ethalfluralin.

Exposure Scenario	Species	Scientific Name	Exposure Duration	Toxicity Reference Value (µg a.i./L)	Endpoints Affected	Reference (Classification)
Freshwater Fish						
Acute	Bluegill Sunfish	*Lepomis macrochirus*	96 hours	LC_{50} = 32	Mortality	Acc. No.00135183 Very Highly Toxic (Acceptable)
Acute	Rainbow Trout	*Oncorhynchus mykiss*	96 hours	LC_{50} = 37	Mortality	Acc. No. 00135183 Very Highly Toxic (Acceptable)

Chronic	Rainbow Trout	*Oncorhynchus mykiss*	60 day	NOAEC/ LOAEC = 0.4/1.4	Larval survival, length, weight	MRID 41994901 (Acceptable)
Freshwater Invertebrate						
Acute	Waterflea	*Daphnia magna*	96 hours	LC_{50} =60	Mortality	Acc. No. 070677 Very highly toxic (Acceptable)
Chronic*	Waterflea	*Daphnia magna*	21 days	NOAEC/ LOAEC =24/ 37	Growth	MRID 42930101 (Acceptable)
Chronic	**Waterflea**	***Daphnia magna***	**21 days**	**NOAEC/ LOAEC =71/ 150**	**Growth**	**MRID 49086902 (Acceptable)**
Estuarine Fish						
Acute	Sheepshead Minnow	*Cyprinodon variegatus*	96 hours	LC_{50}=240	Mortality	MRID 41613904, Highly Toxic (Acceptable)
Chronic	**Sheepshead Minnow**	***Cyprinodon variegatus***	**33 days (ELS)**	**NOAEC/ LOAEC = 1.2 / 2.7**	**Length**	**MRID 48689101** **(Acceptable)**
Estuarine Invertebrates						
Acute	Mysid Shrimp	*Mysidopsis bahia*	96 hours	LC_{50}=230	Mortality	MRID 41613906 Highly Toxic (Acceptable)
Acute	Eastern Oyster	*Crassotrea virginica*	96 hours	LC_{50}=170	Mortality	MRID 42889801 Highly Toxic (Acceptable)
Chronic	**Mysid Shrimp**	***Mysidopsis bahia***	**28 days**	**NOAEC/ LOAEC = 29.1/57.8**	**Offspring produced per female**	**MRID 49037801** **(Acceptable)**
Aquatic Plants						
Non-Vascular	Green Algae	*Pseudokirchneriella swubcapitata* formerly *Selenastrum capricornutum*	120 hours	**IC_{50} = 2**5 **NOAEC=10.9**	Cell Density	MRID 41613912 (Acceptable)
Vascular	**Duckweed**	***Lemna gibba***	**14 days**	**IC_{50} = 7.3**		**MRID 49086901**

				NOAEC=1.7	**Frond number yield**	**(Acceptable)**
Sediment Invertebrates						
Chronic	**Midge**	***Chironomus dilutus***	**10 day**	**NOAEC/ LOAEC =270, >270**	**NA**	**MRID 48975701 Acceptable**
Chronic	**Amphipods**	***Hyalella azteca***	**10 day**	**NOAEC/ LOAEC =92/140**	**Dry weight**	**MRID 48975702 Acceptable**

*When two studies are presented, the most sensitive endpoint will be used for risk assessment purposes.

5.6 Terrestrial Effects Summary

Ethalfluralin is practically non-toxic to both mammals and birds, reptiles and terrestrial-phase amphibians (for which birds serve as surrogates) on an acute oral exposure basis; the compound is also practically non-toxic to birds on a subacute dietary exposure basis. Ethalfluralin is also practically non-toxic to young adult honey bees (*Apis mellifera*) on an acute contact exposure basis. Chronic exposure in both birds and mammals resulted in effects on reproduction.

The effects of ethalfluralin on terrestrial organisms that are used to assess risk in this assessment are listed in **Table 18**. Additionally, four new studies were submitted since the last assessment that include:

1) an acute toxicity study with Japanese quail (*Coturnix japonica*; MRID 48915501);
2) an acute toxicity study with Zebra finch (*Taeniopygia guttata*; MRID 49385904);
3) a vegetative vigor study with the formulated product Sonalan® HP (GF-1740) – 35.1% Ethalfluralin (MRID 48915901); and,
4) a seedling emergence study with the formulated product Sonalan® HP (GF-1740) - 35.1% Ethalfluralin (MRID 49385904).

These studies are presented are marked in bold in **Table 19** of the terrestrial taxa endpoints. Only descriptions of these studies are provided below. Refer to previous assessments for more comprehensive descriptions of the studies that are not included here.

Acute Toxicity to Japanese Quail (*Coturnix japonica)* (MRID 48915501)

The acute oral toxicity of ethalfluralin to Japanese quail was assessed over 14 days in a limit-dose study (MRID 48915501). No mortality, clinical signs of toxicity, or effects on body weight were observed at the limit dose of 2000 mg/kg bw. The acute oral LD_{50} was >2000 mg/kg bw. Ethalfluralin GF-705 is classified as practically non-toxic to the Japanese quail on an acute oral exposure basis. This toxicity study is classified as scientifically sound and satisfies the guideline requirement for an acute oral toxicity study.

Acute Toxicity to the Zebra Finch (*Taeniopygia guttata)* (MRID 48915502)

The acute oral toxicity of ethalfluralin to passerine birds (*i.e*., Zebra finches) was assessed over 14 days in a limit-dose study (MRID 48915502). No mortality, clinical signs of toxicity, or effects on body weight or food consumption were observed in the 2000 mg ai/kg bw group. The acute oral LD_{50} was >2000 mg ai/kg bw. Therefore ethalfluralin is classified as **practically non-toxic** to zebra finches on an acute oral basis. This toxicity study is classified as scientifically sound and satisfies the guideline requirement for an acute oral toxicity study with a passerine species.

Toxicity of Ethalfluralin (Sonalan® HFP GF-1742) to Terrestrial Vascular Plants Vegetative Vigor (MRID 48915901)

The effect of formulated ethalfluralin (Sonalan® GF-1742; 35.1 % ethalfluralin) on the vegetative vigor of monocotyledonous (monocots: grain sorghum, sorghum bicolor; onion, *Allium cepa*; ryegrass, *Lolium perenne*; and oat, *Avena sativa*) and dicotyledonous (dicots: oilseed rape, *Brassica napus*; carrot, *Daucus carola*; soybean, *Glycine max*; cucumber, *Cucumis sativus*; sugar beet, *Beta vulgaris*, and tomato, *Lycopersicon esculentum*) crops was studied at a nominal treatment rates ranging from 0.007 to 1.68 lbs a.i./A (MRID 48915901). The most sensitive monocot was ryegrass, based on decreased fresh weight with NOAEC and IC_{25} values of 0.053 and 0.212 lb ai/A, respectively. The most sensitive dicot species, could not be determined due to a lack of toxicity; NOAEC and EC/IC_{25} values were 1.68 and >1.68 lb ai/A, respectively.

Toxicity of Ethalfluralin (Sonalan® HFP GF-1742) to Terrestrial Vascular Plants Seedling Emergence (MRID 49385904)

The effect of formulated ethalfluralin (Sonalan® GF-1742; 35.1 % ethalfluralin) on the seedling emergence of monocots (corn, *Zea mays*; oat; onion; and ryegrass) and dicot crops (carrot; cucumber; oilseed rape; soybean; sugar beet, *Beta vulgaris*; and tomato) was studied at rates ranging from 0.00328 to 1.68 lb ai/A (MRID 49385904). The most sensitive monocot was ryegrass based on reduced fresh weight, with IC_{05} and EC_{25} values of 0.00195 and 0.0183 lb ai/A, respectively.

The most sensitive dicot species was tomato based on reduced fresh weight, with NOEC and EC_{25} values of 0.105 and 0.139 lb ai/A, respectively. Phytotoxic effects reported included epinasty (bending outward), leaf cupping, lodging, stunting, chlorosis, necrosis, mosaic, leaf wrinkle, and complete mortality.

Table 18. Summary of Toxicity for Terrestrial Taxa Exposed to Ethalfluralin.

Exposure Scenario	Species	Scientific Name	Exposure Duration	Toxicity Reference Value	Effects	Reference (Classification)
Mammals						

Exposure Scenario	Species	Scientific Name	Exposure Duration	Toxicity Reference Value	Effects	Reference (Classification)
Acute	Laboratory Rat	*Rattus norvegicus*	Acute Oral	LD_{50} = 5000 mg/kg bw	Mortality	Acc. No. 00135189 (Acceptable) Practically non-toxic
Chronic	Laboratory Rat	*Rattus norvegicus*	Chronic	NOAEL = 61 mg/kg-bw; LOAEL > 61 mg/kg bw	Reproduction	MRID 43868313, 44073701 (Acceptable)
Invertebrates						
Acute Contact	Honey bee	*Apis mellifera*	48 hours	LD_{50}>51 µg a.i./bee	Mortality	MRID 41613914 (Acceptable) Practically non-toxic
Birds						
Acute (Dose-based)	Bobwhite Quail	*Colinus virginianus*	14days	LD_{50} > 2000 mg a.i./kg	Mortality	Acc. No. 00094760 (Acceptable) Practically non-toxic
Acute (Dose-based)	**Japanese Quail**	***Coturnix coturnix japonica***	**14days**	**LD_{50} >2000 mg a.i./kg bw**	**Mortality**	**MRID 48915501 (Acceptable) Practically non- toxic**
Acute (Dose-based)	Mallard Duck	*Anas platyrhynchos*	14 days	LC_{50} = >5000 mg/kg bw	Mortality	Acc. No. 00094762 (Acceptable) Practically non-toxic
Acute (Dose-based)	**Zebra finch**	***Taeniopygia guttata***	**14 days**	**LD_{50} >2000 mg a.i./kg**	**Mortality**	**MRID 48915502 (Acceptable) Practically non- toxic**
Acute (Dietary-based)	Bobwhite Quail	*Colinus virginianus*	8 days	LC_{50} >5000 mg/kg diet	N/A	Acc. No. 070677 (Acceptable)
Acute (Dietary-based)	Mallard Duck	*Anas platyrhynchos*	8 days	LC_{50} >5000 mg/kg diet	N/A	Acc. No. 070677 (Acceptable)

Exposure Scenario	Species	Scientific Name	Exposure Duration	Toxicity Reference Value	Effects	Reference (Classification)
Chronic	Mallard Duck	*Anas platyrhynchos*	21 weeks Reproduction	NOAEL = 1000 mg/kg diet NOAEL >1000 mg/kg diet	N/A	Acc. No. 00094763 (Acceptable)
Plants						
Seedling Emergence With TGAI	ND (Monocot)	*Sorghum vulgare*	21 days	EC_{25} = 0.09 lb a.i./A NOAEC = 0.06lb a.i./A	Plant weight	Acc. No. 47874101 Acceptable
	Sugar beet (Dicot)	*Beta vulgaris*	21 days	EC_{25} = 0.11 lbs a.i./A NOAEL =0.1048 lbs a.i./A	Fresh Weight	MRID 47874101 (Supplemental)
Seedling Emergence	**ND** **(Monocot)**	***Lolium perenne***	**21 days**	EC_{25} = 0.0183 lb a.i./A IC_{05} = 0.00195 lb a.i./A	**EC05 was used in lieu of NOAEC since IC25 lower than NOEAEC**	**MRID 49385904** **Acceptable**
	Tomato **(Dicot)**	***Lycopersicon esculentum***	**21 days**	**EC_{25} = 0.139 lbs a.i./A** **NOAEL =0.105 lbs a.i./A**	**Fresh Weight**	**MRID 49385904** **(Acceptable)**
Vegetative Vigor with TGAI	Sorghum (Monocot)	*Sorghum vulgare*	21 days	EC_{25} > 1.7 lbs a.i./A NOAEL = 0.43 lbs ai/A	Shoot Length	MRID 43465002 (Acceptable)
	Cotton (Dicot)	*Cotton*	21 days	EC_{25} = 0.27 lbs a.i./A NOAEL = 0.027 lbs a.i./A	Shoot Length	MRID 42904201 (Acceptable)
Vegetative Vigor with GF-1742	**Ryegrass** **(Monocot)**	***Lolium perenne***	**21 days**	**EC_{25} = 0.212 lbs a.i./A** **NOAEL =0.053 lbs a.i./A**	**Fresh Weight**	**MRID 48915901 (Acceptable)**
	ND	***ND***	**21 days**	**EC_{25}>1.68 lbs a.i./A**	**ND**	

Exposure Scenario	Species	Scientific Name	Exposure Duration	Toxicity Reference Value	Effects	Reference (Classification)
	(Dicot)			NOAEL = 1.68lbs a.i./A		

Although ethalfluralin degrades to several minor degradates, they are not expected to be of environmental concern relative to the parent compound.

5.7 ECOTOX Open Literature

Open literature studies are identified using EPA's ECOTOXicology database (ECOTOX) (USEPA, 2007*c*), which employs a literature search engine for locating chemical toxicity data for aquatic life, terrestrial plants, and wildlife. No additional data on ethalfluralin was identified through this review with endpoints more sensitive than those that were submitted.

5.8 Review of Incident Data

Incident reports submitted to EPA since approximately 1994 have been tracked by assignment of "incident numbers" in an Incident Data System (IDS), microfiched, and then entered into a second database, the Ecological Incident Information System (EIIS; USEPA 2007b). An effort has also been made to enter information to EIIS on incident reports received prior to establishment of current databases.

A preliminary review of the EIIS database indicates that there are 99 incidents involving terrestrial plants associated with the use of ethalfluralin since 1996. Incidents were reported in all seasons and resulted from both registered uses as well as occasional misuse of the product of both granular and emulsifiable (EC) formulations. The magnitude of damage ranged from a small area (1 acre) to the entire treated crop and over 800 acres. The incidents ranged from applications in all seasons (spring, summer, autumn and winter) from both granular and spray ground applications. These incidents are detailed in **Table 19.**

Table 19. Summary of Ecological Incidents as found in EIIS from the Usage of Ethalfluralin (Note: In every incident, the taxa affected were terrestrial plants).

Incident ID	Year	Legality	Certainty	State	Application Method	Product	Comments
I013636-042	2002	Registered use	Highly Probable	ND	Broadcast	Sonalan®	Ethalfluralin was applied to dry beans in 2001, and then wheat was planted in 2002. Carryover of ethalfluralin residues may have caused the injury due to extremely dry winter conditions following the harvest of the dry beans

Incident ID	Year	Legality	Certainty	State	Application Method	Product	Comments
I009516-003	1999	Registered Use	Possible	ND	Broadcast	Sonalan® HFP	Canola crop showed decreased growth and abnormal roots. Heavy rain and cold conditions were present shortly before application.
I010927-021	2000	Registered Use	Possible	ND	Spray	Sonalan® HFP	707 acres of soybeans affected by crop stand loss, reported that cool wet soils were prevalent throughout area during the month and may have contributed
I014702-067	2003	Registered use	Possible	ND	Broadcast	Sonalan®	Damaged wheat crop resulting from carryover from sunflower application with severe drought conditions and minimal breakdown of Sonalan®
I008183-001	1997	Undetermined	Possible	CA	Broadcast	Sonalan® HFP	Alleged damage of dry beans due to treatment, excess moisture may have also contributed
I012366-006	2001	Registered use	Possible	IL	N/R	Sonalan® EC	21 acres of damaged apple crops reported, unknown whether application of ethalfluralin was the cause
I012457-016	2001	Undetermined	Possible	GA	N/R	Sonalan®	--
I011444-015	2001	Misuse (accidental)	Possible	GA	N/R	Sonalan®	There is no evidence that ethalfluralin was responsible for the fish kills reported
I010927-025	1998	Undetermined	Possible	Canada	N/R	EDGE	Canola crop damaged when plant failed to emerge properly, a test conducted in June, 1998 found ethalfluralin on canola at 0.58 ppm.
I011838-067	2001	Undetermined	Possible	OK	N/R	Sonalan®	--
I011838-049	2001	Undetermined	Possible	GA	N/R	Sonalan®	--
I007755-023	1998	Registered Use	Possible	ND	Soil incorporation	Sonalan® HFP	Pre-plant incorporation on 47 acres of wheat crop allegedly resulted in swollen roots and root hair growth

Incident ID	Year	Legality	Certainty	State	Application Method	Product	Comments
I014702-066	2003	Registered use	Possible	ND	Broadcast	Sonalan® 10G	Carryover from canola application in 2002 coupled with a severe drought led to damaged stand of durum wheat in 2003
I008323-001	1998	Undetermined	Possible	Canada	N/R	EDGE GRANULAR	Unknown if label directions followed, canola crop allegedly failed to emerge or germinate from seed
I011838-038	2001	Undetermined	Possible	GA	N/R	Sonalan®	--
I011838-037	2001	Undetermined	Possible	GA	N/R	Sonalan®	--
I011838-036	2001	Undetermined	Possible	GA	N/R	Sonalan®	--
I009516-001	1999	Registered Use	Possible	TX	Broadcast	Sonalan® HFP	Application was a possible cause of damage, Dow Agrosciences inspector judged the peanut crop was diseased
I009516-009	1999	Registered Use	Possible	ND	Broadcast	Sonalan® HFP	Dow inspector determined damage to 90 acres of canola after soil sample analysis and plant inspection was more due to FARGO product than Sonalan®
I011838-010	2000	Undetermined	Possible	GA	N/R	Sonalan®	--
I007755-017	1998	Registered Use	Possible	ND	PPI/GROUND/ BROADCAST	Sonalan® 10G	570 acres in wheat crop allegedly demonstrated crop injury after application
I020627-001	2000	Misuse	Possible	WA	N/R	N/R	--
I009515-002	1999	Registered use	Possible	ND	Broadcast	Sonalan® 10G	Stand reduction in canola crop reported
I014702-071	2003	Registered use	Possible	MN	Broadcast	Sonalan®	80 acres of canola damage allegedly due to application of ethalfluralin
I012457-019	2001	Undetermined	Possible	GA	N/R	Sonalan®	--
I011838-066	2001	Undetermined	Possible	OK	N/R	Sonalan®	--

Incident ID	Year	Legality	Certainty	State	Application Method	Product	Comments
I009515-001	1999	Misuse (accidental)	Possible	ND	Soil incorporation	Sonalan® 10G	Poor emergence of wheat reported but may have been due to soil that was inspected to be too wet for seeding
I013550-001	2002	Registered use	Possible	TX	N/R	Sonalan® HFP	Reported that a Sonalan tank may have been contaminated with some source of Picloram, which is not approved for peanuts
I011838-045	2001	Undetermined	Possible	GA	N/R	Sonalan®	--
I011838-046	2001	Undetermined	Possible	GA	N/R	Sonalan®	--
I011838-040	2001	Undetermined	Possible	GA	N/R	PROWL	--
I011838-044	2001	Undetermined	Possible	GA	N/R	Sonalan®	--
I009516-002	1999	Registered Use	Possible	ND	Broadcast	Sonalan® HFP	Soybean crop showed decreased growth and abnormal roots. Heavy rain and cold conditions were present shortly before application.
I011838-042	2001	Undetermined	Possible	GA	N/R	Sonalan®	--
I011838-048	2001	Undetermined	Possible	GA	N/R	Sonalan®	--
I009516-012	1999	Registered Use	Probable	MI	Broadcast	Sonalan® HFP	Damage to 180 acres of beans reported, adjacent area with no spraying showed no symptoms
I009516-006	1999	Registered Use	Probable	ND	Broadcast	Sonalan® HFP	Severe thinning of 30 acres of canola reported
I009516-011	1999	Registered Use	Probable	ND	Broadcast	Sonalan® HFP	Thinning reported in 72 acres of treated canola.
I009516-007	1999	Registered Use	Probable	ND	Broadcast	Sonalan® HFP	Severe thinning of 157 acres of canola reported
I009516-008	1999	Registered Use	Probable	ND	Broadcast	Sonalan HFP	Severe thinning of 110 acres of canola reported
I009516-004	1999	Registered Use	Probable	ND	Broadcast	Sonalan HFP	Severe thinning of 100 acres of canola reported
I010927-020	2000	Undetermined	Probable	ND	N/R	Sonalan® 10G	Determined by Dow inspector that ethalfluralin was applied a year before a mix of trifluralin and triallate, which is known

Incident ID	Year	Legality	Certainty	State	Application Method	Product	Comments
							to have damaging effects on wheat
I010927-018	2000	Misuse (accidental)	Probable	ND	Spray	Sonalan® 10G	--
I010927-026	1999	Registered Use	Probable	Canada	N/R	EDGE	320 acres of canola crop damaged, AFC Agra Services Ltd., concluded ethalfluralin was responsible
I010927-023	2000	Registered Use	Probable	ND	Spray	Sonalan® HFP	It was not determined whether the deep seeding, cold weather, or application of ethalfluralin that caused thinned canola stand
I012366-003	2001	Registered use	Probable	ND	Broadcast	Sonalan HFP	839 acres of canola saw severe crop thinning and poor emergence
I009510-001	1999	Registered Use	Probable	IA	Broadcast	N/R	Soybean crop allegedly damaged by application
I010927-022	2000	Registered Use	Probable	ND	Spray	Sonalan® HFP	500 acres of canola stand was thinned compared to untreated area
I009516-013	1999	Registered Use	Probable	ND	Broadcast	Sonalan® HFP	Poor stand in 195 acres of canola reported
I006196-012	N/R	Registered Use	Probable	ID	N/R	Sonalan®	No analytical data included in report, damage to wheat reported after treatment
I009969-001	1999	Registered Use	Probable	CA	Broadcast	Sonalan® HFP	Bean crop affected when hypocotyl was swollen following emergence, cold weather also may have been a factor
I009516-010	1999	Registered Use	Probable	ND	Broadcast	Sonalan® HFP	Thinning reported in 21 acres of treated canola.
I010927-016	2000	Misuse (accidental)	Probable	ND	Spray	Sonalan® 10G	This use was accidental as the product should not be used on wheat, it was what remained from an application the previous year
I010927-017	2000	Misuse (accidental)	Probable	ND	Spray	Sonalan® 10G	This use was accidental as the product should not be used on wheat, it was what remained from an application the previous year

Incident ID	Year	Legality	Certainty	State	Application Method	Product	Comments
I010927-019	2000	Misuse (accidental)	Probable	ND	Spray	Sonalan® 10G	This use was accidental as the product should not be used on canola, it was what remained from an application the previous year
I012366-005	2000	Registered use	Probable	ND	Broadcast	Sonalan® HFP	129 acres of soybeans showed poor emergence, stunted or slowed yield; a check strip showed a difference from treated vs. non-treated
I006197-009	N/R	Registered Use	Probable	ID	N/R	Sonalan® 10G	No analytical data included in report, abnormal growth reported in wheat crop after treatment
I006196-009	N/R	Registered Use	Probable	ID	N/R	Sonalan®	No analytical data included in report, damage to wheat reported after treatment
I006196-003	N/R	Registered Use	Probable	ND	N/R	Sonalan®	No analytical data included in report, reduced emergence reported in soybean crop after treatment
I006196-004	N/R	Registered Use	Probable	MN	N/R	Sonalan®	No analytical data included in report, reduced emergence reported in soybean crop after treatment
I006196-005	N/R	Registered Use	Probable	ND	N/R	Sonalan®	No analytical data included in report, slow emergence reported in soybean crop after treatment
I006196-006	N/R	Registered Use	Probable	ID	N/R	Sonalan®	No analytical data included in report, poor development of wheat crop after treatment
I003130-001	1996	Registered Use	Probable	MT	N/R	Sonalan®® 10G	Spring crops following pesticide treatment demonstrated a thin stand
I006196-007	N/R	Registered Use	Probable	ID	N/R	Sonalan®	No analytical data included in report, damage to wheat reported after treatment
I006197-011	N/R	Registered Use	Probable	ID	N/R	Sonalan®10G	No analytical data included in report, abnormal growth reported in wheat crop after treatment

Incident ID	Year	Legality	Certainty	State	Application Method	Product	Comments
I006197-003	N/R	Registered Use	Probable	ND	N/R	Sonalan®10G	No analytical data included in report, damage to wheat reported after treatment
I006454-001	1997	Registered Use	Probable	MN	N/R	Sonalan®10 G	The corn crop appeared stunted and pale in color
I009969-002	1999	Undetermined	Probable	CA	Broadcast	Sonalan®HFP	100 acres of beans reported damaged, emergence of beans affected by tank mix of Sonalan®/DUAL
I014702-070	2003	Registered use	Probable	ND	Broadcast	Sonalan®	Damaged wheat crop resulting from carryover from sunflower application with severe drought conditions and minimal breakdown of Sonalan®
I014702-068	2003	Registered use	Probable	ND	Broadcast	Sonalan®	Damaged wheat crop resulting from carryover from sunflower application with severe drought conditions and minimal breakdown of Sonalan®
I013636-045	2002	Registered use	Probable	ND	Broadcast	Sonalan® HFP	Crop damage to beans determined to be due to seed cracks and a damaged embryonic shoot as well as cutworms
I013636-046	2002	Registered use	Probable	ND	Broadcast	Sonalan®	120 acres of canola reported damaged with thin stand, check strip indicated no damage
I014702-069	2003	Registered use	Probable	ND	Broadcast	Sonalan®	Damaged wheat crop resulting from carryover from application with severe drought conditions and minimal breakdown of Sonalan®
I016962-037	2005	Registered Use	Probable	ND	Band, incorporated	Sonalan® HFP	--
I013636-043	2001	Registered Use	Probable	OR	Broadcast	Sonalan® HFP	Carryover of ethalfluralin application to dry beans from grass seed caused damage allegedly
I013636-044	2000	Registered Use	Probable	OR	Broadcast	Sonalan® HFP	Carryover from dry beans in 2000 allegedly caused subsequent crops to be damaged

Incident ID	Year	Legality	Certainty	State	Application Method	Product	Comments
I003146-001	1996	Registered Use	Probable	MN	N/R	Sonalan® HFP	Treated soybean crop demonstrated disease, compaction, delayed emergence, and swollen hypocotyl
I006197-004	N/R	Registered Use	Probable	ND	N/R	Sonalan®10G	No analytical data included in report, thin stand of wheat reported after treatment
I012366-004	2000	Registered Use	Probable	ND	Broadcast	Sonalan® HFP	Soybeans in treated and untreated field had a difference in emergence, stand and yield
I009516-005	1999	Registered Use	Probable	ND	Broadcast	Sonalan®HFP	Severe thinning of 50 acres of canola reported
I006196-011	N/R	Registered Use	Probable	ID	N/R	Sonalan®	No analytical data included in report, damage to wheat reported after treatment
I006196-013	N/R	Registered Use	Probable	MN	N/R	Sonalan®	No analytical data included in report, damage to sugar beets reported after treatment
I006196-014	NR	Registered Use	Probable	ND	N/R	Sonalan®	No analytical data included in report, non-emergence of canola reported after treatment
I006196-015	N/R	Registered Use	Probable	WA	N/R	Sonalan®	No analytical data included in report, damage to dry bean crop reported after treatment
I006196-016	N/R	Registered Use	Probable	MN	N/R	Sonalan®	No analytical data included in report, damage to corn crop reported after treatment
I004810-001	N/R	Registered Use	Probable	ND	N/R	Sonalan®10G	No analytical data included in report, reduced emergence reported in wheat crop after treatment
I006196-001	N/R	Registered Use	Probable	TX	N/R	Sonalan®	No analytical data included in report, reports that peanuts grown were stunted after exposure
I006196-008	N/R	Registered Use	Probable	ID	N/R	Sonalan®	No analytical data included in report, damage to wheat reported after treatment
I006196-010	N/R	Registered Use	Probable	ID	N/R	Sonalan®	No analytical data included in report, damage to wheat reported after treatment

Incident ID	Year	Legality	Certainty	State	Application Method	Product	Comments
I006197-005	N/R	Registered Use	Probable	ND	N/R	Sonalan®10G	No analytical data included in report, poor emergence reported in wheat crop after treatment
I006197-006	N/R	Registered Use	Probable	ND	N/R	Sonalan®10G	No analytical data included in report, damage to wheat reported after treatment
I006197-007	N/R	Registered Use	Probable	ND	N/R	Sonalan®10G	No analytical data included in report, poor emergence reported in wheat crop after treatment
I006197-008	N/R	Registered Use	Probable	ID	N/R	Sonalan®10G	No analytical data included in report, abnormal growth reported in wheat crop after treatment
I006197-010	N/R	Registered Use	Probable	ID	N/R	Sonalan®10G	No analytical data included in report, abnormal growth reported in wheat crop after treatment
I004823-001	1997	Registered Use	Probable	IL	N/R	Sonalan®HFP	Treatment allegedly rendered a crop that demonstrated thin stand, swollen hypocotyls, brown roots, and dying
I006197-001	N/R	Registered Use	Probable	ND	N/R	Sonalan®10G	No analytical data included in report, damage to oats reported after treatment
I006196-002	N/R	Registered Use	Probable	MN	N/R	Sonalan®	No analytical data included in report, reports that soybeans grown were stunted after exposure
I012366-007	2001	Registered use	Probable	MT	N/R	Sonalan®10G	56 acres of dry bean crop damaged due to weeds that were allowed to grow because of ineffective product
I006197-002	N/R	Registered Use	Probable	ND	N/R	Sonalan®10G	No analytical data included in report, slow emergence reported in wheat crop after treatment

The Avian Monitoring Information System (AIMS), which is maintained by the American Bird Conservancy, indicates there are no incidents for wildlife.

An absence of reported incidents should not be construed as the absence of incidents. Incident reports for non-target organisms typically provide information only on mortality events and plant

damage incidents. Except for phytotoxic effects in terrestrial plants, sublethal effects, such as reduced growth or impaired reproduction, are rarely reported. EPA's changes in the registrant reporting requirements for incidents in 1998 may account for a reduced number of reported incidents. Registrants are now only required to submit detailed information on 'major' fish, wildlife, and plant incidents. Minor fish, wildlife, and plant incidents, as well as all other non-target incidents, are generally reported aggregately and are not included in the EIIS. In addition, there have been changes in state monitoring efforts due to a lack of resources. However, the incident data that are available suggest that exposure pathways for ethalfluralin are complete and that exposure levels are sufficient to result in field-observable effects for terrestrial plants.

6 Risk Characterization

Risk characterization is the integration of exposure and effects characterization to determine the potential ecological risk from the use of ethalfluralin and the likelihood of adverse effects on aquatic and terrestrial wildlife/plants based on varying pesticide-use scenarios. The risk characterization provides an estimation and a description of the risk; articulates risk assessment assumptions, limitations, and uncertainties; synthesizes an overall conclusion; and provides the risk managers with information to make regulatory decisions.

6.1 Risk Estimation

Results of the exposure modeling and toxicity effects data are used to evaluate the likelihood of adverse ecological effects on non-target species. For the assessment of ethalfluralin risks, the risk quotient (RQ) method is used to compare exposure and measured toxicity values **(Table 20).** The EECs are divided by the most sensitive acute and chronic toxicity values. The RQs are then compared to the Agency's levels of concern (LOCs). These LOCs, summarized in **Table 20**, are the Agency's interpretive policy and are used to analyze potential risk to non-target organisms and the need to consider regulatory action. These criteria are used to indicate when a pesticide's use as directed on the label has the potential to cause adverse effects on non-target organisms.

Table 20. Risk presumptions for terrestrial animals based on risk quotients (RQ) and levels of concern (LOC).

Risk Presumption	RQ	LOC
	Birds	
Acute Risk	**EEC[1]/LC_{50} or LD_{50}/ft^2 or LD_{50}/day[3]**	**0.5**
Acute Restricted Use	**EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day (or LD_{50} < 50 mg/kg)**	**0.2**
Acute Endangered Species	**EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day**	**0.1**
Chronic Risk	**EEC/NOAEC**	**1**
	Wild Mammals	
Acute Risk	**EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day**	**0.5**
Acute Restricted Use	**EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day (or LD_{50} < 50 mg/kg)**	**0.2**
Acute Endangered Species	**EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day**	**0.1**
Chronic Risk	**EEC/NOAEC**	**1**

[1] abbreviation for Estimated Environmental Concentration (ppm) on avian/mammalian food items
[2] mg/ft^2
[3] mg of toxicant consumed/day
LD_{50} * wt. of bird
LD_{50} * wt. of bird

Risk presumptions for aquatic animals based on risk quotients (RQ) and levels of concern (LOC).

Risk Presumption	RQ	LOC
Acute Risk	**EEC[1]/LC_{50} or EC_{50}**	**0.5**
Acute Restricted Use	**EEC/LC_{50} or EC_{50}**	**0.1**
Acute Endangered Species	**EEC/LC_{50} or EC_{50}**	**0.05**
Chronic Risk	**EEC/NOAEC**	**1**

[1] EEC = (ppm or ppb) in water

Risk presumptions for plants based on risk quotients (RQ) and levels of concern (LOC).

Risk Presumption	RQ	LOC
	Terrestrial and Semi-Aquatic Plants	
Acute Risk	EEC[1]/EC_{25}	1
Acute Endangered Species	EEC/EC_{05} or NOAEC	1
	Aquatic Plants	
Acute Risk	EEC[2]/EC_{50}	1
Acute Endangered Species	EEC/EC_{05} or NOAEC	1

[1] EEC = lbs ai/A
2 EEC = (ppb/ppm) in water

6.2 Non-target Aquatic Animals and Plants

6.2.1 Acute Risk to Aquatic Animals

Acute RQs were derived for exposure of freshwater and estuarine/marine fish and invertebrates to ethalfluralin for application rates ranging from 0.75 lbs a.i. /A to 1.7 lbs a.i. /A **(Table 21).** Acute RQs for freshwater fish range from 0.11 to 0.39 and exceed the LOCs for acute risk to listed species (LOC=0.05) but not for non-listed species (LOC= 0.5). Similarly, acute RQs ranging from 0.06 to 0.21 for freshwater invertebrates exceed the LOC for acute risk to listed species. For estuarine/marine fish and invertebrates, the LOC for listed species is only exceeded at the highest application rate with RQs of 0.05 and 0.07 respectively. There are no LOC exceedances for non-listed estuarine/marine species for any crop or application rate.

Table 21. Acute RQs for fish and aquatic invertebrates exposed to ethalfluralin.

Use	App. Date	App. Rate lb/A	Peak	FW Fish	FW Invert	SW Fish	SW Invert	FW Fish	FW Invert	SW Fish	SW Invert
				LC_{50} (µg/L)	EC_{50} (µg/L)	LC_{50} (µg/L)	EC_{50} (µg/L)	RQ	RQ	RQ	RQ
Cucurbits	30-Oct	1.7	12.5	32	60	240	170	**0.39**[a]	**0.21**[a]	**0.05**[a]	**0.07**[a]
Cucurbits	30-Oct	0.75	5.52	32	60	240	170	**0.17**[a]	**0.09**[a]	0.02	0.03
Sunflower	10-Jun	1.7	5.91	32	60	240	170	**0.18**[a]	**0.10**[a]	0.02	0.03
Soybean	10-Oct	1.31	6.02	32	60	240	170	**0.19**[a]	**0.10**[a]	0.03	0.04
Peanut	1-May	1.15	4.12	32	60	240	170	**0.13**[a]	**0.07**[a]	0.02	0.02
Potatoes	10-May	1.03	3.54	32	60	240	170	**0.11**[a]	**0.06**[a]	0.01	0.02

[a] **Bolded values denote that the RQ exceeds acute risk to listed species level of concern (LOC) of 0.05. The non-listed species LOC is 0.5.**

6.2.2 Chronic Risk to Aquatic Animals

Chronic RQs were derived for exposure of freshwater fish and invertebrates and estuarine/marine invertebrates to ethalfluralin **(Table 22).** The chronic RQs for freshwater fish range from 1.0 to 3.4 and exceed the chronic risk LOC (1.0) for every application rate and crop modeled. For estuarine/marine fish, the RQ only exceeds the LOC at the highest application rate with an RQ of 1.13. None of the RQs (ranging from 0.03 to 0.15) for estuarine/marine and freshwater invertebrates exceed the chronic risk LOC for any use or application rate modeled,

Table 22. Chronic RQs for fish and aquatic invertebrates exposed to ethalfluralin.

Use	App. Rate lb/A	Estimated Environmental Concentration(µg/L)		SW Invert	FW Invert	SW Fish	FW Fish	SW Invert	FW Invert	SW Fish	FW Fish
		21-day	60-day	NOAEC (µg/L)	NOAEC (µg/L)	NOAEC (µg/L)	NOAEC (µg/L)	RQ	RQ	RQ	RQ
Cucurbits	1.7	3.55	1.36	29.1	24	1.200	0.40	0.12	0.15	**1.13**[a]	**3.40**[a]
Cucurbits	0.75	1.57	0.6	29.1	24	1.200	0.40	0.05	0.07	0.50	**1.50**[a]

Sunflower	1.7	1.59	0.63	29.1	24	1.200	0.40	0.05	0.07	0.53	**1.58[a]**
Soybean	1.31	1.41	0.59	29.1	24	1.200	0.40	0.05	0.06	0.49	**1.48[a]**
Peanut	1.15	1.37	0.57	29.1	24	1.200	0.40	0.05	0.06	0.48	**1.43[a]**
Potatoes	1.03	1.01	0.4	29.1	24	1.200	0.40	0.03	0.04	0.33	**1.00[a]**

* Fish toxicity data are compared to the 60-day EEC while the invertebrate toxicity data are compared to the 21-day EEC.
[a] **Bolded values indicate RQs exceeds, the chronic risk level of concern (LOC) of 1.0.**

6.2.3 Risk to Sediment-dwelling Invertebrates

Chronic RQs were derived for freshwater sediment-dwelling invertebrates using both pore water and sediment-based EECs and the toxicity endpoints for both *Hyallela sp. and Chironomous sp.* The sediment-based EECs are normalized to the organic carbon (OC) content of the sediment. The RQs based on pore water do not exceed the chronic risk LOC of 1.0 for any application rate or use modeled and are <0.01 in all cases **(Table 23).** The OC-normalized sediment-based RQs for *Hyalella* range from 1.3 to 4 and exceed the chronic risk LOC for all uses and application rates modeled **(Table 24).** The OC-normalized sediment-based RQs for *Chironomous* range from 0.13 to 0.4 and do not exceed the chronic risk LOC for any scenario modeled. There are no data available for the benthic estuarine/marine species of *Leptocheirus.* Although RQ values for the freshwater midges did not exceed the chronic risk LOC, those for Hyalella exceed the chronic risk LOC. Given the propensity of ethalfluralin to bind to the sediments, risk is presumed to estuarine/marine sediment-dwelling invertebrates (based on sediment OC-normalized EECs) until more information is received to permit evaluation of risks.

Table 23. Porewater-based RQs for freshwater sediment-dwelling invertebrates.

Model Scenario Use		**Maximum Application rate lbs a.i./A**	**Porewater EEC (µg/L)**	***Hyalella***	***Chironomous***	***Hyalella***	***Chironomous***
			21-day	**Porewater NOAEC (µg/L)**	**Porewater NOAEC (µg/L)**	**Porewater RQ**	**Porewater RQ**
Cucurbits		1.7	0.33	92	270	<0.01	<0.01
Sunflower		1.7	0.28	92	270	<0.01	<0.01
Peanut		1.15	0.19	92	270	<0.01	<0.01
Potatoes		1.03	0.19	92	270	<0.01	<0.01

Table 24. Organic carbon normalized sediment based RQs for freshwater sediment dwelling invertebrates.

Model Scenario Use	**Maximum Application rate lbs a.i./A**	**Sediment EEC (µg/L)**	***Hyalella***	***Chironomous***	***Hyalella***	***Chironomous***
		Sediment µg ai/Kg-OC	**Sediment (µg ai/Kg-OC)**	**Sediment (µg ai/Kg-OC)**	**Sediment OC normalized RQ**	**Sediment OC normalized RQ**
Cucurbits	1.7	1939.75	480	4800	**4.04[a]**	0.40
Sunflower	1.7	1117	480	4800	**2.33[a]**	0.23
Peanut	1.15	750	480	4800	**1.56[a]**	0.16
Potatoes	1.03	625	480	4800	**1.30[a]**	0.13

[a] **Bolded values indicate RQs exceeds, the chronic risk level of concern (LOC) of 1.0**

6.2.4 Risk to Aquatic Plants

The RQs for non-listed vascular plants only exceed the LOC of 1.0 for the highest application rate modeled with an RQ of 1.7. The RQs for listed vascular plants range from 3.0 to 10.4 and exceed the LOC of 1.0 for every use and application rate modeled **(Table 25)**. None of the RQs for non-vascular plants exceed the LOC of 1.0 for any application rate or use modeled with the exception of the RQ for listed non-vascular plants at the highest application rate.

Table 25. RQs for non-vascular and vascular aquatic plants exposed to ethalfluralin.

Model Scenario Use	Maximum Application rate lbs a.i./A	EEC (µg/L)	Toxicity Values				RQs			
			Non-Vascular Plant		Vascular Plant		Non-Vascular Plant		Vascular Plant	
		Peak	Non-listed EC_{50}	Listed NOAEC	Non-listed EC_{50}	Listed NOAEC	Non-listed	Listed	Non-listed	Listed
Cucurbits	1.7	12.5	25.30	10.90	7.30	1.20	0.5	**1.1**[a]	**1.7**[b]	**10.4**[a]
Cucurbits	0.75	5.52	25.30	10.90	7.30	1.20	0.2	0.5	0.8	**4.6**[a]
Sunflower	1.7	5.91	25.30	10.90	7.30	1.20	0.2	0.5	0.8	**4.9**[a]
Soybean	1.31	6.02	25.30	10.90	7.30	1.20	0.2	0.6	0.8	**5.0**[a]
Peanut	1.15	4.12	25.30	10.90	7.30	1.20	0.2	0.4	0.6	**3.4**[a]
Potatoes	1.03	3.54	25.30	10.90	7.30	1.20	0.1	0.3	0.5	**3.0**[a]

[a] **Bolded** RQ exceeds the risk to listed species LOC.
[b] **Bolded** RQ exceeds the risk to non-listed species LOC

6.3 Non-target Terrestrial Animals

6.3.1 Acute Risk to Birds and Mammals

Ethalfluralin is characterized as practically non-toxic to birds on both an acute oral and subacute dietary exposure basis. Avian acute toxicity tests did not have any observed mortality, and therefore no definitive toxicity values with the endpoints being greater than values of the highest doses tested. Therefore, avian acute RQs were not calculated. The acute endpoint for mammals is 5000 mg/kg (MRID 00135189) and is ethalfluralin is considered practically non-toxic to mammals on an acute oral exposure basis. None of the RQs exceed the LOC for either listed species (LOC=0.1) or unlisted species (LOC=0.5). Acute risk to birds and mammals is not anticipated through either emulsifiable concentrate or granular formulations through registered uses of ethalfluralin.

6.3.2 Chronic Risk to Birds and Mammals

Avian Species

The NOAEC in the chronic bird toxicity studies was 1,000 ppm, but no adverse effects were observed in these studies. The maximum acute EEC for the proposed uses is 462 ppm for residues on short grasses from the alfalfa use with an application rate of 1.69 lbs a.i. /A. Therefore, even if effects had been observed at the 1000 ppm level, RQ values would not exceed the chronic risk LOC of 1.0.

Mammalian Species

The previous assessment did not identify any chronic risk to mammals (DP# D205884, D296985, and D296987). The endpoint used in that assessment could not be confirmed for use in this assessment. Therefore, this assessment utilized the chronic toxicity value of 61 mg/kg bw based on reduced reproduction. Utilizing this endpoint, dose-based RQ values exceed the chronic risk LOC; however, dietary-based RQ values for uses of emulsifiable concentrates do not exceed the chronic risk LOC **(Table 26)**. RQs based on upper-bound Kenaga values ranged from 0.01 to 3.3. RQs for small- and medium-sized mammals (15 g and 35 g mammals, respectively) exceed the chronic risk LOC of 1.0 for short grass, tall grass, broadleaf plants for uses on alfalfa, cucurbits, potatoes and sunflower with application rates that ranged from 1 to 1.69 lbs a.i./A. RQs at the highest application rate of 1.69 also exceed the chronic risk LOC for mammals foraging on arthropods. RQs for large (1000 gram) mammals only exceed the chronic risk LOC of 1 for short grass for application rates greater than 1.3 lbs a.i./A. Chronic risk from dietary exposure was not identified for mammals at any application rate for spray formulations.

Table 26. Chronic dose-based RQs for mammals exposed to proposed spray uses of ethalfluralin.

	15 gram "Small" Mammal						**35 gram "Medium" Mammal**						**1000 gram "Large" Mammal**					
Use (application rate lbs a.i./A)	**Short Grass**	**Tall Grass**	**Broadleaf Plants**	**Fruits/pods**	**Arthropods**	**Seeds**	**Short Grass**	**Tall Grass**	**Broadleaf Plants**	**Fruits/pods**	**Arthropods**	**Seeds**	**Short Grass**	**Tall Grass**	**Broadleaf Plants**	**Fruits/pods**	**Arthropods**	**Seeds**
Alfalfa with low broadcast spray (1.698)	**2.9**	**1.3**	**1.6**	0.2	**1.1**	0.0	**2.5**	**1.1**	**1.4**	0.2	**1.0**	0.0	**1.3**	0.6	0.7	0.1	0.5	0.0
Potatoes chemigation (1.028)	**1.8**	0.8	**1.0**	0.1	0.7	0.0	1.5	0.7	0.8	0.1	0.6	0.0	0.8	0.4	0.5	0.1	0.3	0.0
Sunflower (1.3) granular, incorporated, chemigation	**2.2**	**1.0**	**1.2**	0.1	0.9	0.0	**1.9**	0.9	**1.1**	0.1	0.7	0.0	**1.0**	0.5	0.6	0.1	0.4	0.0

6.3.3 Risks to Piscivorous Birds and Mammals

Ethalfluralin has the ability to bioaccumulate/magnify in the aquatic food chain. In order to assess the magnitude of risk the KABAM model was used to predict the level of concern to higher trophic levels in aquatic food webs. The only LOC exceedance to piscivorous mammals

feeding on fish containing ethalfluralin residues is from chronic exposure of the large river otter (RQ = 1.1) at the highest application rate of 1.69 lb ai/A. The RQs for the other mammals modeled ranged from 0.28 for water shrew to 0.7 for small river otter. The RQs for mammalian acute exposure do not exceed the acute risk LOC for any group at the highest application rate. The RQs for avian acute and chronic exposure feeding on fish containing ethalfluralin residues do not exceed acute or chronic risk LOCs at the highest application rate modeled (1.69 lbs ai/A). The one chronic RQ for mammals that exceeded the LOC at the 1.7 lbs ai/A level did not exceed the LOC at the next highest application rate modeled of 1.3 lbs ai/A. Ethalfluralin is expected to depurate in mammal tissues by 50% within three days ounces exposure stops. The KABAM model did not assume any depuration so the one exceedance is likely a worst case scenario and risk to piscivorous birds and mammals is likely low.

6.3.4 Risk to Non-target Terrestrial Plants

There were two new studies using a formulated end product that have been incorporated into the risk assessment for plants. The vegetative vigor study determined that monocots were more sensitive to formulated ethalfluralin than TGAI whereas dicots were more sensitive to TGAI than the formulated end product. The seedling emergence study with formulated end product had more sensitive endpoints for both monocots and dicots than the previous TGAI study. RQs were determined using the lowest available endpoint for both monocots and dicots in both the vegetative vigor and seedling emergence studies. The EC25 and NOAEC in the vegetative vigor studies were 0.212 and 0.053 lbs ai/A respectively for monocots and 0.27 and 0.027 respectively for dicots. The EC25 and NOAEC in the seedling emergence studies were 0.0183 and 0.00195 lbs ai/A respectively for monocots and 0.139 and 0.105 respectively for dicots.

RQs resulting from off-site transport from runoff and spray drift of ethalfluralin are presented below. In general, monocots were more sensitive to ethalfluralin than dicots.

Monocotyledon Species

RQs for monocots range from <0.1 to 130.7 **(Table 27).** RQs values for plants exposed to runoff and spray drift in semi-aquatic areas exceed the risk to non-listed and listed species LOCs for every use and application rate modeled.

Table 27. Monocot RQs from applications of ethalfluralin in the modeled scenarios of Runoff and Spray Drift in Dry areas, Runoff and Spray Drift in Semi-Aquatic Areas, and Spray Drift only.

Use (application rate lbs a.i./A)	Monocot RQ Values					
	Runoff and Spray Drift (Dry Areas)		Runoff and Spray Drift (Semi-Aquatic Areas)		Spray Drift Only	
	Non-listed Species	Listed Species	Non-listed Species	Listed Species	Non-listed Species	Listed Species

Alfalfa, Beans with low broadcast spray EC1 (1.698)	**1.86[b]**	**17.44[a]**	**10.22 [b]**	**95.90[a]**	0.93	**8.72 [a]**
Alfalfa, Beans with chemigation EC3 (1.698)	**5.57 [b]**	**52.31[a]**	**13.93 [b]**	**130.77[a]**	**4.64 [b]**	**43.59 [a]**
Beans granular (1.69)	0.92	**8.67[a]**	**9.23 [b]**	**86.67[a]**	<0.1	<0.1
Clover 3" incorporated (1.5)	**1.23 [b]**	**11.54[a]**	**4.92 [b]**	**46.15[a]**	0.82	**7.69 [a]**
Cucurbits with low broadcast spray (1.7)	**1.86 [b]**	**17.44[a]**	**10.22 [b]**	**95.90[a]**	0.93	**8.72 [a]**
Dill ground spray (1.13)	0.93	**8.69[a]**	**3.70 [b]**	**34.77[a]**	0.62	**5.79 [a]**
Lentils, Mustard granular formulation 2" incorporation (0.95)	0.26	**2.44[a]**	**2.60 [b]**	**24.36[a]**	<0.1	<0.1
Oilseed-Sunflower, Jojoba, *etc* (1.7) Granular 2 inch incorporation	0.46	**4.36[a]**	**4.64 [b]**	**43.59[a]**	<0.1	<0.1
Oilseed-Sunflower, Jojoba, *etc* (1.7) Granular F 3 inch incorporation	0.17	**1.62[a]**	**1.73 [b]**	**16.24[a]**	<0.1	<0.1
Oilseed-Sunflower, Jojoba, *etc* (1.7) EC3 chemigation	**5.57 [b]**	**52.31[a]**	**13.93 [b]**	**130.7[a]**	**4.64 [b]**	**43.59 [a]**
Oilseed – Crambe, Rapeseed (canola), *etc*. group (0.95) EC2 spray with 2 inch incorporation	0.78	**7.31[a]**	**3.11 [b]**	**29.23[a]**	0.52	**4.87 [a]**
Oilseed – Crambe, Rapeseed (canola), *etc*. group (0.95) G with 2 inch incorporation	0.26	**2.44[a]**	**2.60 [b]**	**24.36[a]**	<0.1	<0.1
Oilseed-Safflower (1.15) granular with 2 inch incorporation	0.31	**2.95[a]**	**3.14 [b]**	**29.49[a]**	<0.1	<0.1
Peanuts granular formulation (1.15) with 2 inch incorporation	0.31	**2.95[a]**	**3.14 [b]**	**29.49[a]**	<0.1	<0.1
Peanuts EC with 2 inch incorporated (1.15)	0.94	**8.85[a]**	**3.77 [b]**	**35.38[a]**	0.63	**5.90 [a]**
Peas EC (0.75) 2 inch incorporation	0.61	**5.77[a]**	**2.46 [b]**	**23.08[a]**	0.41	**3.85 [a]**
Peas granular formulation (0.75) 2 inch incorporation	0.20	**1.92[a]**	**2.05 [b]**	**19.23[a]**	<0.1	<0.1

Potatoes chemigation (1.028)	**3.37** [b]	**31.63**[a]	**8.43** [b]	**79.08**[a]	**2.81**	**26.36** [a]
Potatoes ground (1.028)	0.84	**7.91**[a]	**3.37** [b]	**31.63**[a]	0.56	**5.27** [a]
Soybeans Granular (1.3) 2 inch incorporation	0.36	**3.33**[a]	**3.55** [b]	**33.33**[a]	<0.1	<0.1

[a] **Bolded** RQ exceeds the risk to listed species LOC.
[b] **Bolded** RQ exceeds the risk to non-listed species LOC

Dicotyledon Species

RQs for dicots ranged from <0.01 to 2.43 **(Table 28).** RQs for only six of the twenty uses exceeded the LOC for listed and non-listed dicot species. Application rates for these uses ranged from 1 to 1.7 lbs a.i. /A.

Table 28. Dicot RQs from applications of ethalfluralin in the modeled scenarios of Runoff and Spray Drift in Dry areas, Runoff and Spray Drift in Semi-Aquatic Areas, and Spray Drift only.

Use (application rate lbs a.i./A)	**Dicot RQ Values**					
	Runoff and Spray Drift (Dry Areas)		**Runoff and Spray Drift (Semi-Aquatic Areas)**		**Spray Drift Only**	
	Non-listed Species	**Listed Species**	**Non-listed Species**	**Listed Species**	**Non-listed Species**	**Listed Species**
Alfalfa, Beans with low broadcast spray (1.698)	0.24	0.32	**1.35** [b]	**1.78**[a]	0.12	0.16
Alfalfa, Beans with chemigation EC3 (1.698)	0.73	0.97	**1.83** [b]	**2.43**[a]	0.61	0.81
Beans granular (1.69)	0.12	0.16	**1.22** [b]	**1.61**[a]	<0.1	<0.1
Clover 3" incorporated (1.5)	0.16	0.21	0.65	0.86	0.11	0.14
Cucurbits with low broadcast spray (1.7)	0.24	0.32	**1.35** [b]	**1.78**[a]	0.12	0.16
Dill ground spray (1.13)	0.12	0.16	0.49	0.65	<0.1	0.11
Lentils granular formulation 2" incorporation (0.95)	<0.1	<0.1	0.34	0.45	<0.1	<0.1
Oilseed-Sunflower, Jojoba, etc (1.7) Granular 2 inch incorporation	<0.1	<0.1	0.61	0.81	<0.1	<0.1

Use (application rate lbs a.i./A)	Dicot RQ Values					
	Runoff and Spray Drift (Dry Areas)		Runoff and Spray Drift (Semi-Aquatic Areas)		Spray Drift Only	
	Non-listed Species	Listed Species	Non-listed Species	Listed Species	Non-listed Species	Listed Species
Oilseed-Sunflower, Jojoba, etc (1.7) Granular F 3 inch incorporation	<0.1	<0.1	0.23	0.30	<0.1	<0.1
Oilseed-Sunflower, Jojoba, etc (1.7) EC3 chemigation	0.73	0.97	**1.83**[b]	**2.43**[a]	0.61	0.81
Oilseed – Crambe, Rapeseed (canola), etc. group (0.95) EC2 spray with 3 inch incorporation	0.10	0.14	0.41	0.54	<0.1	<0.1
Oilseed – Crambe, Rapeseed (canola), etc. group (0.95) G with 2 inch incorporation	<0.1	<0.1	0.30	0.45	<0.1	<0.1
Oilseed-Safflower (1.15) granular with 2 inch incorporation	0.10	0.14	0.41	0.54	<0.1	<0.1
Peanuts granular formulation (1.15) with 2 inch incorporation	0.10	0.14	0.41	0.54	<0.1	<0.1
Peanuts EC with 2 inch incorporated (1.15)	0.12	0.16	0.50	0.66	<0.1	0.11
Peas EC (0.75) 2 inch incorporation	<0.1	0.11	0.32	0.43	<0.1	<0.1
Peas granular formulation (0.76)	<0.1	<0.1	0.30	0.40	<0.1	<0.1
Potatoes chemigation (1.028)	0.44	0.59	**1.11**[b]	**1.47**[a]	0.37	0.49
Potatoes ground (1.028)	0.11	0.15	0.44	0.59	<0.1	<0.1
Soybeans Granular (1.3) 2 inch incorporation	<0.1	<0.1	0.47	0.62	<0.1	<0.1

[a] **Bolded** RQ exceeds the risk to listed species LOC.

[b] Bolded RQ exceeds the risk to non-listed species LOC

6.3.5 Risk to Terrestrial Invertebrates

Bees may be exposed to ethalfluralin via direct applications, drift from boom or aerial spray, or from residues on plants adjacent to treated fields. There are no acute or chronic toxicity studies submitted for larval bees or any acute oral or chronic toxicity studies for adult bees. Therefore, RQs resulting from contact exposure to ethalfluralin residues are presented in **Table 29**. The RQs are less than values because the toxicity endpoint did not show any toxicity at the highest concentrations tested.

Table 29. Contact RQs for bees that result from applications of ethalfluralin.

Use (application rate lbs a.i./A)	Contact Exposure
Alfalfa with low broadcast spray (1.698)	<1.1
Cucurbits with low broadcast spray (1.932)	<1.2
Potatoes chemigation (1.028)	<0.6
Sunflower (1.3) granular, incorporated, chemigation	<0.8

Using calculations from Bee-Rex modeling, the RQs for contact range from <0.6 to <1.2 which, based on absolute value, exceed the Agency's established acute risk LOC of 0.4. The acute contact toxicity study did not indicate any adverse effects at the highest concentration tested of 51 µg/bee, and ethalfluralin is classified as practically non-toxic to adult bees on an acute contact exposure basis. The RQs generated are thus the result of non-definitive toxicity estimate and the high application rates leading EECs that range from 33 µg/bee to 61 µg/bee. There is significant uncertainty in these acute RQs as well as the lack of data on chronic effects. The extent of exposure is uncertain as well since pre-plant timing of application may reduce exposure to pollinators if early in the growing season when plants are not flowering. If the acute oral endpoint was similar to that of the contact study (>51 µg/bee) which was practically non-toxic, RQs would range from <0.05 to <0.1.

7 Risk Description

7.1 Risk to Non-Target Aquatic Organisms

Ethalfluralin is applied as both a spray (physically incorporated or wetted in) and in granular form and non-target aquatic taxa may come into contact with ethalfluralin as a result of spray drift or runoff. Ethalfluralin may still however reach water bodies due to runoff but the high organic carbon partition coefficient suggests an affinity to bind to sediment thereby decreasing water column concentrations. Additionally, ethalfluralin concentrations in surface water should be limited by its susceptibility to photolysis in water (half-life = 6.3 hours) but is somewhat more persistent in turbid waters and in low light environments.

Aquatic Animals

The acute studies with freshwater and estuarine/marine fish and invertebrates using TGAI indicate that ethalfluralin is very highly toxic to estuarine/marine fish, freshwater fish, and freshwater invertebrates, and is highly toxic to estuarine/marine invertebrates on acute exposure basis. The EECs result in RQs for freshwater taxa that exceed LOC for acute risk to listed species but not for non-listed species. The LOC for acute risk to listed estuarine/marine species is only exceeded at the highest concentration modeled and RQs do not exceed the acute risk to non-listed LOC.

To further analyze the potential risk from ethalfluralin use to aquatic species, the AgDrift model was used to predict spray drift deposition, and to determine the distance from the edge of the treated site where the risk from spray drift alone is equal to the LOC for acute risk to listed and non-listed aquatic species. It is important to recognize, though, that risk from runoff is not considered in this analysis. Elimination of spray drift may reduce the impact to water column taxa as demonstrated by **Table 30** and **Table 31**. Effects distances, defined as the distance within which spray drift may adversely affect water column taxa ranged from 3 feet to 65 feet for listed species when using a low boom and high boom, respectively, with very fine to fine droplet sizes. Increasing the droplet sizes to fine or medium coarse (median droplet size of 341 µm) reduces the effect distance to 0 **(Table 31.)**

Table 30. Buffer distances for aquatic taxa using very fine to fine droplet sizes.

Aquatic Animals					
Use (application rate lbs a.i./A)	**Application Method**	**EFFECTS DISTANCES**			
		Very fine to fine Droplet sized (175 µm)			
		High boom (1.27 m)		**Low Boom (0.5 m height)**	
		Non-listed	Listed	Non-listed	Listed
1.69 / 1.7	Ground	0	65	0	7
1.5/1.52	Ground	0	53	0	3
1.15/1.13	Ground	0	33	0	3
1.0/ 0.95	Ground	0	23	0	0
Freshwater Fish LC_{50} 32 µg a.i./A;					

Table 31. Buffer distances for aquatic taxa using fine to medium coarse droplet sizes.

Aquatic Animals			
Use (application rate lbs a.i./A)	**Application Method**	**EFFECTS DISTANCES**	
		Fine to Medium Coarse Droplet sized (341 µm)	
		High boom (1.27 m)	**Low Boom (0.5 m height)**

		Non-listed	Listed	Non-listed	Listed
1.69 / 1.7	Ground	0	0	0	0
1.5/1.52	Ground	0	0	0	0
1.15/1.13	Ground	0	0	0	0
1.0/ 0.95	Ground	0	0	0	0
Freshwater Fish LC_{50} 32 µg a.i./A;					

The RQs for freshwater fish exceed the chronic risk LOC at application rates of 1 lb ai. /A and higher. The RQs for estuarine/marine fish exceed the chronic risk LOC only at the highest application rate while the RQs for invertebrates in either freshwater or estuarine/marine environments do not exceed the chronic risk LOC at any of the application rates modeled. Based on the available data, there is potential for acute and chronic risks to aquatic animals. Additional potential for indirect effects to these species also exist because of the risk to aquatic plants (see below). Many aquatic animals are directly and/or indirectly dependent upon aquatic plants for food and/or shelter during various life-stages.

Ethalfluralin has a high propensity to bind to sediment particles. While this property may reduce chronic risk to water column taxa, RQs indicate that freshwater sediment-dwelling invertebrates may be at risk. Chronic RQs derived from 10-day toxicity tests for *Hyalella sp*. range from 1.3 to 4 and exceed the chronic risk LOC at all of the application rates modeled; however, the RQs based on a 10-day toxicity test with *Chironomous* range from 0.13 to 0.4 and do not exceed the chronic risk LOC. For both freshwater species, the sub-chronic 10-day test is often less sensitive than the full 28-day chronic test. Thus these RQs may represent lower-bound estimates of risk and in order to more fully understand risk to sediment-dwelling invertebrates, a 28-day chronic toxicity test may be needed. Additionally, a sediment toxicity test with an estuarine/marine species was not submitted. Until these data are available, potential risk to estuarine/marine sediment-dwelling invertebrates is presumed when they are exposed to ethalfluralin on a chronic basis.

Aquatic Plants

Based on data and the predicted aquatic exposures, the likelihood of adverse effects on non-listed species non-vascular aquatic plants is considered low; however, at the highest application rate, the RQ for listed non-vascular plants exceeds the LOC. Similarly, the only LOC exceedance for non-listed vascular plants is at the highest application rate modeled. RQ values exceed the LOC for risk to listed vascular plants at all application rates modeled (RQs 3 – 10; **Table 25**).

The contribution of spray drift to the overall risk to aquatic plants may be effectively mitigated by adjusting the boom height and droplet sizes to minimize impacts from spray drift. The distance from aquatic water bodies that ethalfluralin may be applied without adversely impacting aquatic plants is reduced from 59 feet to 7 feet for listed species by lowering the boom height when using the highest application rates **(Table 32).** This effect distance dropped to zero from increasing the droplet size for all scenarios modeled **(Table 33).**

Table 32. Buffer distances from spray applications with very fine to fine droplet sizes.

Aquatic Plants					
Use (application rate lbs a.i./A)	Application Method	Effects Distances			
		Very fine to fine Droplet sized (175 µm)			
		High boom (1.27 m)		Low Boom (0.5 m height)	
		Non-listed	Listed	Non-listed	Listed
1.69 / 1.7	Ground	0	59	0	7
1.5/1.52	Ground	0	46	0	3
1.15/1.13	Ground	0	26	0	3
1.0/ 0.95	Ground	0	20	0	0
L. gibba LC_{50} 7.3 µg a.i./A; NOAEC = 1.7 µg ai/A					

Table 33. Buffer distances from spray applications with fine to medium/coarse droplet sizes.

Aquatic Plants					
Use (application rate lbs a.i./A)	Application Method	Effects Distances			
		Fine to Medium Coarse Droplet sized (341 µm)			
		High boom (1.27 m)		Low Boom (0.5 m height)	
		Non-listed	Listed	Non-listed	Listed
1.69 / 1.7	Ground	0	0	0	0
1.5/1.52	Ground	0	0	0	0
1.15/1.13	Ground	0	0	0	0
1.0/ 0.95	Ground	0	0	0	0
L. gibba LC_{50} 7.3 µg a.i./A; NOAEC = 1.7 µg ai/A					

7.2 Risk to Non-Target Terrestrial Organisms

The magnitude and duration of adverse effects resulting from acute and chronic exposure via intake of ethalfluralin residues for birds and mammals is discussed below. The likelihood of exposure is increased given the moderate persistence of ethalfluralin in terrestrial environments (half-lives ranging between 23–51 days).

Birds

- **Acute Risk (Oral-based)**

Based on the submitted acute oral toxicity studies on birds, ethalfluralin is categorized as practically non-toxic to birds on an acute oral exposure basis. An oral toxicity test with a passerine species was recently provided; based on this study ethalfluralin is practically non-toxic to passerines and these data are similar to results for mallard duck (*Anas platyrhynchos*) and bobwhite quail (*Colinus virginianus*). Similar to the previous assessment, no risk identified for birds on an acute oral exposure basis from either granular or emulsifiable concentrate formulations.

- **Chronic Risk (Dietary-based)**

The NOAEC in the chronic bird toxicity studies was 1,000 ppm, but no adverse effects were observed in these studies. The maximum EEC for the proposed uses would be 406 ppm for short grass residues from the alfalfa use. Therefore, even if effects had been observed at the 1000 ppm level, chronic risks would not be expected.

Since birds serve as surrogates for terrestrial-phase amphibians and reptiles, the low likelihood of adverse effects on birds from either acute or chronic exposure to ethalfluralin extends to these taxa as well.

Mammals

- **Acute Risk (Oral-based)**

Ethalfluralin is practically non-toxic to mammals on an acute oral exposure basis. There are no acute risk LOC exceedances for any application rates for either emulsified concentrate or granular formulations. Therefore, the likelihood of adverse effects to mammals from acute exposure to ethalfluralin is considered low.

- **Chronic Risk (Dose and Dietary-based)**

Dose-based RQ values are above the chronic risk LOC for all size classes of mammals for unincorporated uses on alfalfa, cucurbits, potatoes, and sunflower with application rates of 1.3 lbs. a.i. or higher. RQs range from 1.0 (for large mammals feeding on short grass exposed to the lowest application rate) to 3.3 for small mammals feeding on short grass at the highest application rate of 1.69 lbs a.i. /A. For small- and medium-sized mammals, RQ values exceed the chronic risk LOC for short grass, tall grass, broadleaf plants and arthropods (**Table 26)**. These chronic risk estimates differ from the previous assessment as a result of a new endpoint (NOAEC = 61 mg/kg-bw based on reproductive effects; MRIDs 43868313 and 44073701) and higher application rates. To provide a lower bound to the estimates of risk to mammals resulting from chronic exposure to ethalfluralin, RQs using mean Kenaga residue values in addition to upper-bound values were calculated. Using the non-conservative mean residue values, implying that higher predicted residue values are expected half the time, chronic dose-based RQs only exceed the chronic risk LOC of 1.0 for small mammals feeding on short grass at the highest

application rates modeled (*i.e.*, 1.69 lbs ai/A). RQs calculated using mean Kenaga values exceed the dose-based chronic risk LOC only for small mammals feeding on short grass exposed the highest application rate (RQ =1.02). Using mean Kenaga values did not result in any other RQs that exceeded the LOC. Consistent with the previous assessment, dietary-based RQ values do not exceed that chronic risk LOC.

Piscivorous Birds and Mammals

The only LOC exceedance to piscivorous mammals feeding on fish containing ethalfluralin residues is from chronic exposure of the large river otter (RQ = 1.1) at the highest application rate of 1.69 lb ai/A. The RQs for the other mammals modeled range from 0.28 for water shrew to 0.7 for small river otter. The RQs for mammalian acute exposure do not exceed the acute risk LOCs for any group at the highest concentration rate. The RQs for birds based on acute and chronic exposure from feeding on fish containing ethalfluralin residues do not exceed either the acute or chronic risk LOCs at the highest application rate modeled (1.7 lbs ai/A). The one chronic RQ for mammals that exceeds the LOC at the 1.7 lbs ai/A level does not exceed the LOC at the next highest application rate modeled (1.3 lbs ai/A). While ethalfluralin's log K_{ow} is 5.11, suggesting the potential for ethalfluralin residues to partition into fatty tissues, bioconcentration studies suggest that the compound is rapidly metabolized (MRID 41994902) and excreted (depurated) once exposure ceases. The BCF ranged from 1330 µg/L in whole fish to 1560 µg/L in muscle with a depuration half-life of three days after exposure ceased (MRID 41994902). The BCF predicted by the KABAM model ranged from 5889 µg/L to 6191 µg/L for small and large fish respectively without any metabolism of ethalfluralin. Ethalfluralin is expected to depurate by 50% within 3 days once exposure is stopped making the estimates from the KABAM model highly conservative. The metabolism of ethalfluralin, coupled with low acute toxicity to birds and mammals, suggest the potential for adverse effects from acute or chronic exposure to ethalfluralin residues in fish is relatively low except for large mammals where the chronic risk LOC is exceeded at the maximum application rate of 1.69 lbs a.i./A.

Terrestrial Invertebrates

Results of the acute contact toxicity studies with honey bees demonstrate that ethalfluralin TGAI is practically non-toxic to beneficial insects on an acute contact exposure basis (LD_{50} >51 µg a.i. /bee). While the absolute value of RQs for acute risk is above the acute risk LOC of 0.4, all the actual values are less than values since the acute contact study did not achieve a definitive LD_{50}. Toxicity data for chronic exposure of adult and larval honeybees to ethalfluralin as well as acute exposure to larval honeybees are not available; therefore, there is more uncertainty as to the potential risk to these castes from other exposure routes to ethalfluralin.

Terrestrial Plants

- **Runoff and Spray Drift Exposure**

Based on the seedling emergence test with terrestrial plants, ethalfluralin is more toxic to monocots than to dicots. The EC_{25} and NOAEC in the seedling emergence tests are 0.0183 lbs ai/A and 0.00195 lbs ai/A, respectively, for monocots versus 0.139 lbs ai/A and 0.105 lbs ai/A,

respectively, for dicots. In contrast to the seedling emergence toxicity tests, ethalfluralin is less toxic to both monocots and dicots in vegetative vigor tests. The EC_{25} and NOAEC in the vegetative vigor tests are 0.212 lbs ai/A and 0.053 lbs ai/A, respectively, for monocots and 0.27 lbs ai/A and 0.027 lbs ai/A, respectively, for dicots. Current terrestrial phytotoxicity data and the predicted exposures from the TerrPlant model indicate potential risk to non-listed and listed monocot and dicot terrestrial and semi-aquatic plant species. Monocot RQs range from 2 to 130 in semi-aquatic areas; dicot RQs range from 0.2 to 2.4 in semi-aquatic areas.

To further analyze the potential risk from ethalfluralin use to non-target plants, the AgDrift model was used to predict spray drift deposition, and to determine the distance from the edge of the treated site where the risk from spray drift alone is equal to the LOC for listed and non-listed plants. Beyond these distances, the risk from spray drift alone is not expected to exceed the LOC. **Table 34** and **Table 35** provide effects distances for both monocots and dicots respectively using the default droplet size distributions in the AgDRIFT model for ground applications (droplet sizes per the American Society of Agricultural and Biological Engineers or ASABE: very fine to fine for ground applications). This is done since ethalfluralin labels do not specify droplet size distributions. Ground applications are modeled with both high and low boom applications (1.27 and 0.5 meters above the ground respectively).

For monocots, spray drift effects distances resulting from low boom ground applications range from 7 feet for non-listed species at the lowest application rate, to 30 feet for listed species exposed to the highest application rates (**Table 34)**. These spray drift effects distances increase for high boom applications and range from 13 feet for non-listed species at the lowest application rate to 82 feet for listed species at the highest application rate.

Table 34. Modeled spray drift buffer distances needed to mitigate risk to the most sensitive monocot species for applications with very fine to fine droplet size spectrum (ground applications).

Monocot Effects Distances					
Use (application rate lbs a.i./A)	**Application Method**	**BUFFER DISTANCES for ground application**			
		Very fine to fine Droplet Size (175 µm)			
		High boom (1.27 m)		**Low Boom (0.5 m height)**	
		Non-listed	**Listed**	**Non-listed**	**Listed**
1.69 / 1.7	Ground	23	82	10	30
1.5/1.52	Ground	20	72	10	26
1.15/1.13	Ground	16	56	7	20
1.0/ 0.95	Ground	13	49	7	20
MONOCOT EC_{25} 0.212; NOAEC 0.053					

Table 35. Modeled spray drift buffer distances needed to mitigate risk to the most sensitive dicot species for applications with very fine to fine droplet size spectrum (ground applications)

Dicot Buffer Distances		
		Buffer distances for ground application

Use (application rate lbs a.i./A)	Application Method	Very fine to fine Droplet Size (175 µm)			
		High boom (1.27 m)		Low Boom (0.5m height)	
		Non-listed	listed	Non-listed	listed
1.69 / 1.7	Ground	20	157	7	59
1.5/1.52	Ground	16	141	7	49
1.15/1.13	Ground	13	108	7	39
1.0/ 0.95	Ground	10	95	7	33
DICOT EC_{25} 0.27; NOAEC 0.027					

For dicots, spray drift effect distances that result from low boom ground applications range from 7 feet for non-listed species at the lowest application rate to 59 feet for listed species exposed to the highest application rates **(Table 35)**. These effect distances increase for high boom applications and range from 10 feet for non-listed species at the lowest application rate to 157 feet for listed species at the highest application rates.

Table 36. Modeled spray drift buffer distances needed to mitigate risk to the most sensitive monocot species for applications with fine to medium coarse droplet sizes (ground applications).

Monocot Buffer Distances					
Use (application rate lbs a.i./A)	Application Method	BUFFER DISTANCES for Coarse droplet sizes for ground application			
		Fine to Medium Coarse Droplet Size (341 µm)			
		High boom (1.27 m)		Low Boom (0.5 m height)	
		Non-listed	Listed	Non-listed	Listed
1.69 / 1.7	Ground	7	16	3	10
1.5/1.52	Ground	3	16	3	10
1.15/1.13	Ground	3	13	3	7
1.0/ 0.95	Ground	3	10	3	7
MONOCOT EC_{25} 0.212; NOAEC 0.053					

Table 37. Modeled spray drift buffer distances needed to mitigate risk to the most sensitive dicot species for applications with fine to medium coarse droplet sizes (ground applications).

Dicot Buffer Distances			
Use (application rate lbs a.i./A)	Application Method	BUFFER DISTANCES for Coarse droplet sizes for ground application	
		Fine to Medium Coarse Droplet Size (341 µm)	
		High boom (1.27 m)	Low Boom (0.5 m height)

		Non-listed	Listed	Non-listed	Listed
1.69 / 1.7	Ground	3	36	3	20
1.5/1.52	Ground	3	33	3	20
1.15/1.13	Ground	3	23	3	13
1.0/ 0.95	Ground	3	20	3	13
DICOT EC_{25} 0.27; NOAEC 0.027					

The AgDRIFT model was also run with the coarsest droplet sizes for ground applications in order to evaluate spray drift buffer distances with larger droplet sizes which may be more common with pre-emergent herbicide applications and to explore the narrowest buffers possible to mitigate the risks due to spray drift with the current ethalfluralin uses. The spray drift buffer distances required to mitigate risk for ground applications with fine to medium/coarse droplet sizes ($D_{V0.5}$ droplet size = 341 microns) with a low boom range from 3 feet for non-listed monocot species to 10 feet for listed monocot species at the lowest and highest application rates respectively (**Table 36**). The buffer distances required to mitigate risk for ground applications with a low boom range from 3 feet for non-listed dicot species to 20 feet for listed dicot species at the lowest and highest application rates, respectively (**Table 37**). Buffer distances are also provided for a high boom scenario as well since labels often say to position height of boom for uniform coverage but to limit drift.

8 Uncertainties, Data Gaps, Assumptions, and Limitations

- **Environmental Fate**

The environmental fate database for ethalfluralin is essentially complete with no major data gaps identified. However, some of the aerobic soil metabolism studies have been determined to be supplemental and resolution of the study uncertainties could increase the confidence regarding the persistence of ethalfluralin in aerobic soils. Overall, besides these uncertainties, the available data give a largely complete picture of a herbicide with moderate environmental persistence (generally persisting for weeks to months), and moderately high volatility, strong soil / sediment sorption and partitioning into organic material.

- **Ecological Effects and Data Gaps.**

The ecological effects data are largely complete with the exception of a chronic toxicity test for estuarine/marine benthic invertebrates and additional pollinator studies. There is a high degree of uncertainty regarding risk to bees due to a non-definitive endpoint and no adverse effects at the highest concentration tested in the acute contact study with adult bees. There are no acute or chronic toxicity studies submitted for larval bees or any acute oral or chronic toxicity studies for adult bees. Additionally risk was identified for freshwater sediment invertebrates but a similar study was not submitted.

Data gaps for this chemical are listed below: feeding studies for adult bees. In the absence of this data, risk is presumed in these compartments as well.

1. Whole sediment toxicity testing with an estuarine/marine sediment dwelling invertebrate **(Guideline 850.1735)**
2. Tier 1 Acute oral toxicity to adult honeybees **(Non-guideline; OECD 213)**
3. Tier 1 Acute oral toxicity to larval honeybees **(Non-guideline; OECD 237)**
4. Tier 1 Chronic oral toxicity to adult honey bees **(Non-guideline)**
5. Tier 1 Chronic oral toxicity to larval honey bees **(Non-guideline)**
6. Tier 2 Pollinator feeding/semi-field study - The need for these studies is contingent upon the results of lower tier bee studies **(Non-guideline)**
7. Tier 2 Pollen and nectar residue studies – The need for these studies is contingent upon the results of lower tier bee studies **(Non-guideline)**
8. Tier 2 Field testing for pollinators – The need for field testing is contingent upon the results of lower tier bee studies **(850.3040)**

In the absence of this data, risk is presumed in these compartments as well.

- **Aquatic Exposure**

In general, upper-bound aquatic exposure estimates for ethalfluralin presented in this risk assessment are sufficiently conservatively reflect exposure under the most vulnerable conditions in high use areas. Monitoring data taken from sites without intensive ethalfluralin usage suggest low aquatic exposure to dissolved ethalfluralin with concentrations almost always below 0.1 ppb. Also relevant to the level of confidence in the aquatic exposure estimates is the low usage profile, which has been on the decline in recent years. For example, the most recent annual usage level is estimated to be less than 1.4 million pounds of active ingredient over the entire United States in 2013. The usage is spread over a large portion of U.S. agricultural lands but at relatively low intensities, with nearly all reporting districts showing overall usage intensities below about 0.05 lb ai / acre. Aquatic environmental exposures, by contrast were modeled as a 100% of the watershed at maximum label rates, making upper bound exposures highly conservative.

- **Terrestrial Exposure**

Toxic response is a function of duration and intensity of exposure. For many compounds, an oral dose represents a very short-term high intensity exposure. Although the dose-based estimates may not reflect reality in that animals do not receive a bolus dose while feeding, it is possible that a short-duration, high-intensity exposure could occur associated with feeding on an agricultural field since many birds may gorge themselves when food items are available. While the dietary-based estimates may suggest greater "realism," they too suffer from some uncertainties. Primarily, the dietary-based approach assumes that animals in the field are consuming food at a rate similar to that of confined laboratory animals despite the fact that energy content in food items differs between the field and the laboratory as does the energy requirements of wild and captive animals.

Other uncertainties with ethalfluralin are related to the representativeness of T-REX with pre-emergent applications. Risks indicated by T-REX due to ethalfluralin residues on seeds or arthropods located within treated fields are most certain with its pre-emergent applications. However, for risks related to broadleaf plants which may be a surrogate to crops, exposure may occur with the uptake of ethalfluralin residues in the soil as well as any residual residues that are remain in the plant system from the seed after germination. However, it should be noted that the extent to which ethalfluralin is systemic is unknown. While a rough indicator, ethalfluralin's log K_{ow} of 5.11 suggests some ability for ethalfluralin to remain within the plant material for some period of time. Dinitroaniline herbicides are absorbed somewhat by plant root systems, and to a greater extent by young seedling shoot organs such as the hypocotyl or coleoptile. Little or no translocation of these herbicides occurs in plants (Parka and Sopa, 1977).

- ***Other General Uncertainties for Screening Risk Assessments***

Routes of Exposure

The screening assessment does not consider ethalfluralin dermal exposure to terrestrial organisms. The Agency is actively pursuing modeling techniques to account for dermal exposure via direct application of spray and by incidental contact with contaminated vegetation, soil and water. Additionally, exposure from inhalation is not assessed. While the compound is moderately volatile, its atmospheric half-life is limited given its propensity to react with hydroxyl radicals and undergo photolysis.

Age Class and Sensitivity of Effects Thresholds

It is generally recognized that test organism age may have a significant impact on the observed sensitivity to a toxicant. Acute toxicity data for fish are collected on juvenile fish, and aquatic invertebrate acute toxicity testing is performed on recommended immature age classes. Similarly, acute dietary testing with birds is also performed on juveniles.

Testing of juveniles may overestimate the toxicity of direct acting pesticides in adults. As juvenile organisms may not have fully developed metabolic systems and may not possess the ability to transform and detoxify xenobiotics equivalent to the older/adult organism. The screening-level risk assessment has no current provisions for a generally applied method that accounts for this uncertainty. In so far as the available toxicity data may provide ranges of sensitivity information with respect to age class, the risk assessment uses the most sensitive life-stage information as the conservative screening endpoint.

Lack of Effects Data for Amphibians and Reptiles

Currently, toxicity studies on amphibians and reptiles are not required for pesticide registration. Since these data are lacking, the Agency uses fish as surrogates for aquatic-phase amphibians and birds as surrogates for terrestrial-phase amphibians and reptiles. If other species are more or less sensitive to ethalfluralin than the surrogates, risks may be under- or overestimated, respectively. The Agency is not limited to a base set of surrogate toxicity information in

establishing risk assessment conclusions. The Agency also considers toxicity data on non-standard test species when available. Further research is needed to determine whether, in general, reptiles and terrestrial-phase amphibians are suitably represented by bird species in assessing risks for ethalfluralin and fish are an appropriate surrogate for aquatic-phase amphibians.

Use of the Most Sensitive Species Tested

Although the screening-level risk assessment relies on a selected toxicity endpoint from the most sensitive species tested, it does not necessarily mean that the selected toxicity endpoints reflect sensitivity of the most sensitive species existing in a given environment. The relative position of the most sensitive species tested in the distribution of all possible species is a function of the overall variability among species to a particular chemical. The relationship between the sensitivity of the most sensitive tested species versus wild species (including listed species) is unknown and a source of significant uncertainty. In addition, in the case of listed species, there is uncertainty regarding the relationship of the listed species' sensitivity and the most sensitive species tested.

Sublethal Effects

When assessing acute risk, the screening-level risk assessment relies on the acute mortality endpoint as well as a suite of sublethal responses to the pesticide. Consideration of additional sublethal data in the effects determination is exercised on a case-by-case basis and only after careful consideration of the nature of the sublethal effect measured and the extent and quality of available data to support establishing a plausible relationship between the measure of effect (sublethal endpoint) and the assessment endpoints. However, the full suite of sublethal effects from valid open literature studies is considered for the characterization purposes within the context of the extent to which the effects can be linked to assessment endpoints of impaired growth, survival or reproduction.

To the extent to which sublethal effects are not considered in this assessment, the potential direct and indirect effects of ethalfluralin on listed species may be underestimated.

Terrestrial Plants

The EC_{25} and NOAEC values from terrestrial plant studies only assess the effects on initial plant growth and survival. EPA current tests do not provide information on effects to reproduction, fruit formation or fruit yield. However, it is currently assumed that a 25 percent or greater effect on initial plant growth is indicative of subsequent reductions on plant populations, fruit formation and yield. In addition, the number of laboratory test species only account for eight of the 300 known plant families. The range of sensitivity of various plants to a phytotoxicant can be significantly higher than that exhibited in the laboratory because of intraspecies and interspecies variability, genetic differences in adaptability to environmental stresses, and magnitude and duration of exposure.

9 Endocrine Disruptor Screening Program

As required by FIFRA and FFDCA, EPA reviews numerous studies to assess potential adverse outcomes from exposure to chemicals. Collectively, these studies include acute, subchronic and chronic toxicity, including assessments of carcinogenicity, neurotoxicity, developmental, reproductive, and general or systemic toxicity. These studies include endpoints, which may be susceptible to endocrine influence, including effects on endocrine target organ histopathology, organ weights, estrus cyclicity, sexual maturation, fertility, pregnancy rates, reproductive loss, and sex ratios in offspring. For ecological hazard assessments, EPA evaluates acute tests and chronic studies that assess growth, developmental and reproductive effects in different taxonomic groups. As part of registration review for ethalfluralin, EPA reviewed these data and selected the most sensitive endpoints for relevant risk assessment scenarios from the existing hazard database. However, as required by FFDCA section 408(p), ethalfluralin is subject to the endocrine screening part of the Endocrine Disruptor Screening Program (EDSP).

EPA has developed the EDSP to determine whether certain substances (including pesticide active and other ingredients) may have an effect in humans or wildlife similar to an effect produced by a "naturally occurring estrogen, or other such endocrine effects as the Administrator may designate." The EDSP employs a two-tiered approach to making the statutorily required determinations. Tier 1 consists of a battery of 11 screening assays to identify the potential of a chemical substance to interact with the estrogen, androgen, or thyroid (E, A, or T) hormonal systems. Chemicals that go through Tier 1 screening and are found to have the potential to interact with E, A, or T hormonal systems will proceed to the next stage of the EDSP where EPA will determine which, if any, of the Tier 2 tests are necessary based on the available data. Tier 2 testing is designed to identify any adverse endocrine-related effects caused by the substance, and establish a dose-response relationship between the dose and the E, A, or T effect.

Under FFDCA section 408(p), the EPA must screen all pesticide chemicals. Between October 2009 and February 2010, EPA issued test orders/data call-ins for the first group of 67 chemicals, which contains 58 pesticide active ingredients and 9 inert ingredients. A second list of chemicals identified for EDSP screening was published on June 14, 2013[12] and includes some pesticides scheduled for registration review and chemicals found in water. Neither of these lists should be construed as a list of known or likely endocrine disruptors. Ethalfluralin is not on List 1. For further information on the status of the EDSP, the policies and procedures, the lists of chemicals, future lists, the test guidelines and the Tier 1 screening battery, please visit our website.[13]

10 Federally Threatened and Endangered (Listed) Species of Concern

Before completing this Registration Review, the Agency will conduct an ecological risk assessment to address the Agency's obligations under both the Endangered Species Act (ESA) and FIFRA. While the risk assessment supporting this proposed interim Registration Review

[12] See http://www.regulations.gov/#!documentDetail;D=EPA-HQ-OPPT-2009-0477-0074 for the final second list of chemicals.

[13] http://www.epa.gov/endo/

decision evaluates risks to species that are not subject to the ESA, EPA is still in the process of conducting a risk assessment for endangered and threatened (listed) species and their designated critical habitats for ethalfluralin. In this proposed interim decision, therefore, EPA has not completed effects determinations for listed species associated with the registered uses of ethalfluralin.

At this time, EPA has not fully developed its risk assessment process for listed species. In November 2013, the EPA, along with the U.S. Fish & Wildlife Service (USFWS), the National Marine Fisheries Service (NMFS) (collectively, the Services), and the U.S. Department of Agriculture (USDA) released a summary of their joint Interim Approaches for assessing risks to listed species from pesticides. The Interim Approaches were developed jointly by the Agencies in response to the National Academy of Sciences' (NAS) recommendations and reflect a common approach to risk assessment shared by the Agencies as a way of addressing scientific differences between the EPA and the Services. The NAS report, available at http://www.nap.edu/catalog.php?record_id=18344, outlines recommendations on specific scientific and technical issues related to the development of pesticide risk assessments that EPA and the Services must conduct in connection with their obligations under the ESA and FIFRA. The joint Interim Approaches were released prior to a stakeholder workshop held on November 15, 2013. In addition, the EPA presented the joint Interim Approaches at the December 2013 Pesticide Program Dialogue Committee (PPDC) and State-FIFRA Issues Research and Evaluation Group (SFIREG) meetings, allowing additional opportunities for stakeholders to comment on the Interim Approaches. As part of a phased, iterative process for developing the Interim Approaches, the Agencies will also consider public comments on the Interim Approaches in connection with the development of upcoming Registration Review decisions. The details of the joint Interim Approaches are contained in the white paper "Interim Approaches for National-Level Pesticide Endangered Species Act Assessments Based on the Recommendations of the National Academy of Sciences April 2013 Report," dated November 1, 2013, available at http://www.epa.gov/espp/2013/nas.html.

11 Conclusions

Ethalfluralin is characterized as having low to moderate persistence; although the compound is subject to relatively rapid photolysis, the conditions (clear, shallow water) favoring this route of abiotic degradation may be limited. The compound is mostly immobile in soil; however, it can move to adjacent waters via spray drift and runoff of sediment-bound residues (erosion). While the compound is moderately volatile, its atmospheric half-life is limited given its propensity to react with hydroxyl radicals and undergo photolysis. Given the limited solubility of ethalfluralin and its propensity to sorb to organic matter, the compound is expected to be associated with benthic sediments in aquatic systems rather than dispersed in the water column.

When estimates of ethalfluralin exposure in terrestrial and aquatic environments are compared to the available ecotoxicity data, the results of the screening-level assessment indicate a potential risks of concern for both aquatic and terrestrial taxa for current uses of ethalfluralin. RQ values exceed the acute and chronic risk LOCs for freshwater and estuarine fish (**Table 38**); since fish serve as surrogates for aquatic-phase amphibians, these risk concerns extend to this taxon as

well. Acute RQ values also exceed the acute risk LOC for estuarine/marine invertebrates and in the absence of data to the contrary, chronic risk is presumed for estuarine/marine sediment-dwelling invertebrates (**Table 38**). Risk concerns are also identified for aquatic plants. In the terrestrial environment, risk concerns are identified for mammals from chronic exposure as well as to terrestrial plants **(Table 39).**

Ethalfluralin is very highly toxic to aquatic animals. In general, risk quotients for aquatic organisms are calculated considering parent compound alone. Acute risk concerns exist for endangered freshwater fish and invertebrates (RQs 0.06 – 0.39) and endangered estuarine / marine fish and invertebrates at the highest application rates (RQs 0.05-0.07). Chronic risk concerns exist for freshwater fish from multiple application rates (RQs 1.0 to 3.4) and to estuarine/marine fish at the highest application rate (RQ = 1.13) but not to aquatic invertebrates. Sediment-dwelling freshwater invertebrates were also determined to be at risk from chronic exposure to sediment (RQs 1.3-4.0). Risk is identified to non-listed aquatic vascular plants only at the highest application rates (RQ = 1.7). Risk to listed vascular plants is identified for application rates ranging from 1 to 1.7 lbs ai/A with RQs from 3 to 10.4. Risk to listed non-vascular plants is only identified at the highest application rate of 1.7 lbs ai/A (RQ = 1.1). Buffers to mitigate risk to listed aquatic plants and animals range from 0 to 65 feet. Ensuring large droplet sizes and low boom heights could substantially reduce impact of spray drift to the aquatic environment though runoff would still contribute to exposure.

For terrestrial wildlife, ethalfluralin is practically non-toxic to birds, mammals, and terrestrial insects on an acute exposure basis. Since the time of the problem formulation, the Agency now also requires acute and chronic toxicity studies for larval bees and chronic toxicity studies for adult bees. While ethalfluralin is classified as practically non-toxic to honey bees on an acute contact exposure basis, the potential impacts of ethalfluralin on adult and larval bees from chronic exposure is uncertain.

No risk is identified for either non-listed or listed birds from acute or chronic exposure to ethalfluralin. While dietary-based RQs are below the chronic risk LOC, dose-based RQ values exceed the chronic risk LOC for mammals for foliar applications of emulsifiable concentrates (RQs ranged from 0.01 to 3.3). RQs for small- and medium-sized mammals (15 g and 35 g mammals respectively) exceed the chronic LOC of 1.0 for short grass, tall grass, broadleaf plants for uses on alfalfa, cucurbits, potatoes and sunflower with application rates that ranged from 1 to 1.9 lbs a.i./A. There is also potential risk to piscivorous mammals from chronic exposure with one LOC exceedance for the large river otter at the highest application rate (RQ 1.1).

Consistent with the herbicidal uses of ethalfluralin, risks of concern are identified for terrestrial plants for all of the uses/rates evaluated. Terrestrial plant risk was identified for every use of ethalfluralin (non-listed and listed RQs ranging between <0.1 – 131); both runoff and spray drift processes contribute to the overall risk. Buffers required to mitigate the spray drift to terrestrial plants range from 7 feet to 157 feet depending on application method and application rate.

The overall risk conclusions for aquatic and terrestrial taxa broken down by each use of ethalfluralin are presented below in **Table 38** and **Table 39,** respectively.

Table 38. Summary of adverse impacts for aquatic organisms expected from the existing uses of ethalfluralin.

	Adverse Impacts Expected for Aquatic Organisms? (No/Yes: A = Acute, C=Chronic)						
Proposed Use (App. Rate - lbs. a.i./A)	**Freshwater Fish**	**Estuarine/Marine Fish**	**Freshwater Invertebrates(Water Column)**	**Estuarine/ Marine Invertebrates (Water Column)**	**Freshwater and Estuarine/Marine Benthic Invertebrates (Sediment)**	**Freshwater and Estuarine/Marine Benthic Invertebrates (Pore water)**	**Aquatic Plants**
Alfalfa, Beans with low broadcast spray EC1 (1.698)	**Yes^{AC}**	**Yes^{AC}**	No	**Yes^{A}**	**Yes**	No	**Yes**
Alfalfa, Beans with chemigation EC3 (1.698)	**Yes^{AC}**	**Yes^{AC}**	No	**Yes^{A}**	**Yes**	No	**Yes**
Beans granular (1.69)	**Yes^{AC}**	No	No	**Yes^{A}**	**Yes**	No	**Yes**
Clover 3" incorporated (1.5)	No	?	No	No	**Yes**	No	**Yes**
Cucurbits with low broadcast spray (1.7)	**Yes^{AC}**	**Yes^{AC}**	No	**Yes^{A}**	**Yes**	No	**Yes**
Dill ground spray (1.13)	**Yes^{AC}**	No	No	No	**Yes**	No	**Yes**
Lentils, Mustard granular formulation 2" incorporation (0.95)	**Yes^{AC}**	No	No	**Yes^{A}**	**Yes**	No	**Yes**
Oilseed-Sunflower, Jojoba, etc (1.7) Granular 2 inch incorporation	**Yes^{AC}**	No	No	No	**Yes**	No	**Yes**

	Adverse Impacts Expected for Aquatic Organisms? (No/Yes: A = Acute, C=Chronic)						
Proposed Use (App. Rate - lbs. a.i./A)	**Freshwater Fish**	**Estuarine/Marine Fish**	**Freshwater Invertebrates(Water Column)**	**Estuarine/ Marine Invertebrates (Water Column)**	**Freshwater and Estuarine/Marine Benthic Invertebrates (Sediment)**	**Freshwater and Estuarine/Marine Benthic Invertebrates (Pore water)**	**Aquatic Plants**
Oilseed-Sunflower, Jojoba, etc (1.7) Granular F 3 inch incorporation	No	No	No	No	**Yes**	No	**Yes**
Oilseed-Sunflower, Jojoba, etc (1.7) EC3 chemigation	**Yes**[AC]	**Yes**[C]	No	**Yes**[A]	**Yes**	No	**Yes**
Oilseed – Crambe, Rapeseed (canola), etc. group (0.95) EC2 spray with 2 inch incorporation	**Yes**[AC]	No	No	No	**Yes**	No	
Oilseed – Crambe, Rapeseed (canola), etc. group (0.95) G with 2 inch incorporation	No	No	No	No	**Yes**	No	**Yes**
Oilseed-Safflower (1.15) granular with 2 inch incorporation	No	No	No	No	**Yes**	No	**Yes**
Peanuts granular formulation (1.15) with 2 inch incorporation	**Yes**[AC]	No	No	No	**Yes**	No	**Yes**

	Adverse Impacts Expected for Aquatic Organisms? (No/Yes: A = Acute, C=Chronic)						
Proposed Use (App. Rate - lbs. a.i./A)	**Freshwater Fish**	**Estuarine/Marine Fish**	**Freshwater Invertebrates(Water Column)**	**Estuarine/ Marine Invertebrates (Water Column)**	**Freshwater and Estuarine/Marine Benthic Invertebrates (Sediment)**	**Freshwater and Estuarine/Marine Benthic Invertebrates (Pore water)**	**Aquatic Plants**
Peanuts EC with 2 inch incorporated (1.15)	**Yes[AC]**	No	No	No	**Yes**	No	**Yes**
Peas EC (0.75) 2 inch incorporation	**?**	No	No	No	**Yes**	No	**Yes**
Peas granular formulation (0.75) 2 inch incorporation	?	No	No	No	**Yes**	No	**Yes**
Potatoes chemigation (1.028)	**Yes[AC]**	No	No	No	**Yes**	No	**Yes**
Potatoes ground (1.028)	**Yes[AC]**	No	No	No	**Yes**	No	**Yes**
Soybeans Granular (1.3) 2 inch incorporation	**Yes[AC]**	No	No	No	**Yes**	No	**Yes**

Table 39. Summary of adverse impacts for terrestrial organisms expected from the existing uses of ethalfluralin.

Proposed Use (App. Rate - lbs. a.i./A)	**Adverse Impacts Expected for Terrestrial Organisms? (No/Yes: A = Acute, C=Chronic)**					
	Birds	**Mammals**	**Piscivorous Birds**	**Piscivorous Mammals**	**Terrestrial Plants**	**Terrestrial Invertebrates**
Alfalfa, Beans with low broadcast spray EC1 (1.698)	No	**Yes[C]**	No	**Yes[C]**	**Yes**	No

Proposed Use (App. Rate - lbs. a.i./A)	Adverse Impacts Expected for Terrestrial Organisms? (No/Yes: A = Acute, C=Chronic)					
	Birds	**Mammals**	**Piscivorous Birds**	**Piscivorous Mammals**	**Terrestrial Plants**	**Terrestrial Invertebrates**
Alfalfa, Beans with chemigation EC3 (1.698)	No	**Yes[C]**	No	**Yes[C]**	**Yes**	No
Beans granular (1.69)	No	No	No	No	**Yes**	No
Clover 3" incorporated (1.5)	No	No	No	No	**Yes**	No
Cucurbits with low broadcast spray (1.7)	No	**Yes[C]**	No	No	**Yes**	No
Dill ground spray (1.13)	No	**Yes[C]**	No	No	**Yes**	No
Lentils, Mustard granular formulation 2" incorporation (0.95)	No	**Yes[C]**	No	No	**Yes**	No
Oilseed-Sunflower, Jojoba, etc (1.7) Granular 2 inch incorporation	No	No	No	No	**Yes**	No
Oilseed-Sunflower, Jojoba, etc (1.7) Granular F 3 inch incorporation	No	No	No	No	**Yes**	No
Oilseed-Sunflower, Jojoba, etc (1.7) EC3 chemigation	No	**Yes[C]**	No	No	**Yes**	No

Proposed Use (App. Rate - lbs. a.i./A)	Adverse Impacts Expected for Terrestrial Organisms? (No/Yes: A = Acute, C=Chronic)					
	Birds	**Mammals**	**Piscivorous Birds**	**Piscivorous Mammals**	**Terrestrial Plants**	**Terrestrial Invertebrates**
Oilseed – Crambe, Rapeseed (canola), etc. group (0.95) EC2 spray with 2 inch incorporation	No	**Yes[C]**	No	No	**Yes**	No
Oilseed – Crambe, Rapeseed (canola), etc. group (0.95) G with 2 inch incorporation	No	No	No	No	**Yes**	No
Oilseed-Safflower (1.15) granular with 2 inch incorporation	No	No	No	No	**Yes**	No
Peanuts granular formulation (1.15) with 2 inch incorporation	No	No	No	No	**Yes**	No
Peanuts EC with 2 inch incorporated (1.15)	No	No	No	No	**Yes**	No
Peas EC (0.75) 2 inch incorporation	No	No	No	No	**Yes**	No
Peas granular formulation (0.75) 2 inch incorporation	No	No	No	No	**Yes**	No
Potatoes chemigation (1.028)	No	**Yes[C]**	No	No	**Yes**	No

Proposed Use (App. Rate - lbs. a.i./A)	Adverse Impacts Expected for Terrestrial Organisms? (No/Yes: A = Acute, C=Chronic)					
	Birds	**Mammals**	**Piscivorous Birds**	**Piscivorous Mammals**	**Terrestrial Plants**	**Terrestrial Invertebrates**
Potatoes ground (1.028)	No	No	No	No	**Yes**	No
Soybeans Granular (1.3) 2 inch incorporation	No	No	No	No	**Yes**	No

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Appendix A. Environmental Fate and Ecological Effects Data for Ethalfluralin

113101 Ethalfluralin Fate Chemistry Bibliography Final 11/18/13

161-1 Hydrolysis

MRID	Citation Reference
94805	Mosier, J.W.; Sullivan, W.L.; Saunders, D.G. (1976) A Hydrolysis Study on the Herbicide Ethalfluralin. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL: 070676-D)
92062029	Environ Corp. (1990) Dowelanco Phase 3 **Summary of MRID 00094805**. A Hydrolysis Study on the Herbicide Ethalfluralin. Prepared by LILLY RESEARCH LABS. 10 p.

161-2 Photodegradation-water

MRID	Citation Reference
41086401	Carpenter, M.; Fennessey, M. (1988) Determination of the Photolysis of Carbon 14-Ethalfluralin in Aqueous Solution: ABC Second Amended Final Report #36868. Unpublished study prepared by Analytical Bio-Chemistry Laboratories, Inc. 76 p.
41613916	Carpenter, M.; Fennessey, M. (1988) Determination of the Photolysis Rate of ?carbon 14|-Ethalfluralin in Aqueous Solution: Final Re- port (Second Amended). Lab Project Number: 36868. Unpublished study prepared by ABC Labs, Inc. 76 p.
94807	Day, E.W., Jr. (1976) Preliminary Photochemical Studies with the Herbicide Ethalfluralin. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070676-F)
94808	Mosier, J.W.; Saunders, D.G. (1980) Photolysis of Ethalfluralin in Aqueous Solution. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070676-G)
94810	Saunders, D.G.; Sieck, R.F.; Shuey, E.W. (1982) Vapor Phase Photol-ysis of Ethalfluralin. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070676-I)

161-3 Photodegradation-soil

MRID	Citation Reference
94809	Gray, J.E.; Saunders, D.G.; Sieck, R.F.; et al. (1979) Rate of Photolysis of Ethalfluralin on Soil and Glass Plates. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070676-H)
41613917	Dykes, J. (1990) Determination of the Photolysis Rate of carbon 14-Ethalfluralin on the Surface of Soil: Final Report. Lab Project Number 38051. Unpublished study prepared by ABC Labs, Inc. 41 p.

162-1 Aerobic soil metabolism

MRID	Citation Reference
41613918	Graper, L. (1990) Aerobic Metabolism of carbon 14-Ethalfluralin in Sandy Loam Soil: Lab Project Number: ABC 0402. Unpublished study prepared by DowElanco. 37 p.

835.4100 Aerobic soil metabolism

MRID	Citation Reference
48509301	Breaux, N.; Douglas, M.; Chavez-Green, A.; et al. (2011) Dow AgroSciences Response to US EPAs Ethalfluralin Registration Review Docket EPA-OPP-2011-0094. Project Number: NTB053111/OCR. Unpublished study prepared by Dow AgroSciences, LLC. 29 p.
48915601	Diehl, M. (2003) Degradation of (Carbon 14)-Ethalfluralin in Three Soils Incubated Under Aerobic Conditions. Project Number: 842133. Unpublished study prepared by RCC Umweltchemie Ag. 92p.

162-2 Anaerobic soil metabolism

MRID	Citation Reference

41613919	Graper, L. (1990) Anaerobic Metabolism of carbon 14-Ethalfluralin in Sandy Loam Soil: Lab Project Number: ABC 0403. Unpublished study prepared by DowElanco. 41 p.
94812	Golab, T.; Sassic, K.A.; Wooten, H.L. (1981)14C Ethalfluralin An-aerobic Soil Degradation Study: Experiment No. ABC-0111. (Un-published study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070676-K)

162-3 Anaerobic aquatic metab.

MRID	Citation Reference
42930102	Lawrence, B.; Mobley, S.; Kesterson, A. (1993) Anaerobic Aquatic Metabolism of (carbon 14)Ethalfluralin: Lab Project Number: 650: 1516: MET91025. Unpublished study prepared by PTRL East, Inc. 172 p.

163-1 Leach/adsorp/desorption

MRID	Citation Reference
94814	Saunders, D.G.; Smith, S.K.; Sieck, R.F.; et al. (1982) Soil Ad- sorption and Desorption of Ethalfluralin: I-EWD-81-04. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070676-O)
94815	Sullivan, W.; Saunders, D.G. (1976) Aged Leaching Study with the Herbicide Ethalfluralin. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070676-P)
94816	Gray, J.E.; Loh, A.; Sieck, R.F.; et al. (1982) Laboratory Leaching of Ethalfluralin. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070676-Q)
94820	Golab, T.; Sassic, K.A.; Wooten, H.L. (1981) Dissipation of 14C Ethalfluralin from Water-hydrosoil Systems Exposed to Natural Environmental Conditions: Experiment No. ABC-0082. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070676-U)
135185	Loh, A.; Sullivan, W. (1978) Adsorption Coefficient of Ethalfluralin in Soil. (Unpublished study received Aug 24, 1978 under 1471-EX-63;

	submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, IN; CDL:097325-K)
41890102	Saunders, D. (1991) Ethalfluralin Aged Soil Leaching Study: Lab Project No. AAC9047. Unpublished study prepared by Dow-Elanco. 58 p.
42437201	Saunders, D. ; Powers, F. (1987) Adsorption and Desorption of Ethalfluralin on Soil: Lab Project Number: EWD8723. Unpublished study prepared by Lilly Research Laboratories. 74 p.
42437202	Saunders, D.G. and F.L. Powers (1987) Adsorption and Desorption of Ethalfluralin on Soil: Submitted and Performed by DowElanco, Greenfield, Indiana. MRID 42437202

163-2 Volatility - lab

MRID	Citation Reference
42496601	Kesterson, A. (1992) Laboratory Volatility of ?Carbon 14|Ethalfluralin: Lab Project Number: 579: 1488. Unpublished study prepared by PTRL East Inc. 74 p.

164-1 Terrestrial field dissipation

MRID	Citation Reference
28626	Golab, T.; Sherman, W.E.; Wooten, H.L.; et al. (1980) Radiochemical Studies with 14C Ethalfluralin in Soil and Various Primary and Rotational Crop Plants. (Unpublished study received Feb 22, 1980 under 1471-EX-63; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:099264-A)
94818	Golab, T.; Sherman, W.E.; Wooten, H.L.; et al. (1980) Radiochemical Studies with 14C Ethalfluralin in Soil and Various Primary and Rotational Crop Plants. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070676-S)
94819	Decker, O.D.; Sieck, R.F.; Shuey, E.W. (1982) Ethalfluralin Three- year Soil Dissipation Studies. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070676-T)
41441401	Decker, O. (1990) Field Dissipation of Ethalfluralin Following Application of Sonalan to Bare Soil and Seeded with Dry Beans: Lab Project Number: AAC8811. Unpublished study prepared by Dow Elanco. 188 p.

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41978101 Decker, O.D. (1991) Ethalfluralin Dissipation Study. Laboratory ID No. AAC8712. Unpublished Study Performed and Submitted by DowElanco, Indianapolis, IN.

164-2 Aquatic field dissipation

MRID	Citation Reference
94806	Hamelink, J.L.; Loh, A. (1976) Dissipation of Ethalfluralin from Water. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070676-E)
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165-1 Confined rotational crop

MRID	Citation Reference
42930103	O'Neal, S.; Johnson, T. (1993) A Confined Rotational Crop Study with (Carbon 14)-Ethalfluralin: Lab Project Number: 576: 1509. Unpublished study prepared by PTRL East, Inc. 312 p.

165-4 Bioaccumulation in fish

MRID	Citation Reference
41994902	Woodburn, K.; Hansen, S.; Ball, T.; et al. (1991) Ethalfluralin: Bioconcentration in Rainbow Trout (*Oncorhynchus mykiss*): Lab Project Number: ES-DR-0233-3655-1. Unpublished study prepared by Dow Chemical Co., Environmental Tox. & Chem. Research Lab. 44 p.

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94765 Peloso, T.S.; Kline, R.M.; Sieck, R.F.; et al. (1982) The Effect of Ethalfluralin on the Degradation of Cellulose, Starch, and Protein in Soil: I-RMK-81-02. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070677-T)

94766	Kline, R.M.; Knox, J.W.; Sieck, R.F.; et al. (1982) The Effect of Ethalfluralin on Soil Microorganisms. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL: 070677-K)
94767	Kline, R.M.; Knox, T.W.; Zornes, L.L.; et al. (1982) The Effect of Ethalfluralin on Sewage Microorganisms: I-BSD-79-12 & I-BSD-80- 01. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070677-L)
94813	Kline, R.M.; Peloso, J.S.; Sieck, R.F.; et al. (1982) Microbial Interactions--The Effect of Ethalfluralin on Nitrogen Fixation by *Anabaena flos aquae*. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070676-M)
94821	Saunders, D.G.; Sieck, R.F.; Shuey, E.W. (1982) Estimated Water Concentration of Ethalfluralin Following Runoff from a Sonalan-treated Watershed. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070676-V)
112920	Saunders, D.; Sieck, R.; Shuey, E. (1982) Estimated Water Concentration of Ethalfluralin following Runoff from a Sonalan-treated Watershed. (Unpublished study received Sep 2, 1982 under 1471- 122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, IN; CDL:248250-A)
43659501	MacCoy, D.; Crepeau, K.; Kuivila, K. (1995) Dissolved Pesticide Data for the San Joaquin River at Vernalis and the Sacramento River at Sacramento, California, 1991-94: Open File Report 95-110. Prepared by U.S. Geological Survey in cooperation with the U.S. EPA and the California Regional Water Quality Control Board; available from U.S. Government Printing Office. 31 p.
43659502	Crepeau, K.; Domagaiski, J.; Kuivila, K. (1994) Methods of Analysis and Quality-Assurance Practices of the U.S. Geological Survey Organic Laboratory, Sacramento, California--Determination of Pesticides in Water by Solid-Phase Extraction and Capillary-Column Gas Chromatography/Mass Spectrometry: Open File Report 94-362. Prepared by the U.S. Geological Survey; available from U.S. Government Printing Office. 21 p.
94817	Pikal, M.J. (1976) Vapor Pressure of Ethalfluralin. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070676-R)

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63-9 Vapor Pressure

MRID	Citation Reference
42437202	Decker, O. (1987) Vapor Pressure of Ethalfluralin: Lab Project Number: ODD8721. Unpublished study prepared by Lilly Research Laboratories. 11 p.

63-11 Oct/Water partition Coef.

MRID	Citation Reference
41890101	Day, E. (1991) Octanol/Water Partition Coefficient of Ethalfluralin : Lab Project Number: EWD9104. Unpublished study prepared by Lilly Analytical Chemistry Dept. 9 p.

63-13 Stability

MRID	Citation Reference
41613901	Hudson, J.; Smith, C. (1990) Ethalfluralin Technical: Chemical Stability: Lab Project Number: TIL909004. Unpublished study pre- pared by DowElanco. 6 p.
42929601	Stolz, W. (1993) Determination of the Stability of Ethalfluralin Technical to Selected Metals and Metal Ions at Elevated Temperatures: Lab Project Number: FOR93036. Unpublished study prepared by

Appendix B. Ethafluralin ECO Effects Bibliography

Revised August 2015

71-1 Avian Single Dose Oral Toxicity

MRID	Citation Reference
94760	West, H.C.; Kehr, C.C.; Hamelink, T.L.; et al. (1980) The Toxicity of Compound 94961 (Ethalfluralin) to Bobwhite Quail in a 14-day Acute Oral Study: Study No. 7012-78. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL: 070677-E)
135181	Elanco Products Co. (1973) Acute Oral Toxicity--Mallard Duck: Study WF-O-3-73. (Unpublished study received Aug 24, 1978 under 1471-EX-63; CDL:097325-D)
135182	Elanco Products Co. (1973) Acute Oral Toxicity--Bobwhites: Study Q-O-6-73. (Unpublished study received Aug 24, 1978 under 1471- EX-63; CDL:097325-E)
48915502	Hubbard, P.; Beavers, J. (2012) Ethalfluralin TGAI: An Acute Oral Toxicity Study with the Zebra Finch. Project Number: 379/295, 120326. Unpublished study prepared by Wildlife International, Ltd. 35p.

92062002	Environ Corp. (1990) Dowelanco Phase 3 Summary of MRID 00094760. The Toxicity of Compound 94961 (Ethalfluralin) to Bobwhite Quail in a 14-Day Acute Oral Study: Study No. 7012-78. Prepared by LILLY RESEARCH LABS. 11 p.

850.2100 Avian acute oral toxicity test

MRID	Citation Reference
48509301	Breaux, N.; Douglas, M.; Chavez-Green, A.; et al. (2011) Dow AgroSciences Response to US EPAs Ethalfluralin Registration Review Docket EPA-OPP-2011-0094. Project Number: NTB053111/OCR. Unpublished study prepared by Dow AgroSciences, LLC. 29 p.
48915501	Burri, R. (2002) GF-705 Ethalfluralin 333 g/L: Acute Oral Toxicity Test in the Japanese Quail. Project Number: 841916. Unpublished study prepared by RCC Umweltchemie Ag. 56p.
48915502	Hubbard, P.; Beavers, J. (2012) Ethalfluralin TGAI: An Acute Oral Toxicity Study with the Zebra Finch. Project Number: 379/295, 120326. Unpublished study prepared by Wildlife International, Ltd. 35p.

71-2 Avian Dietary Toxicity

MRID	Citation Reference
94761	Kehr, C.C.; Hamelink, T.L.; Brannon, D.R.; et al. (1980) The Toxicity of Compound 94961 (Ethalfluralin) to Bobwhite Quail in a 5-day Dietary Study: Study No. 7028-78. Includes method AVD dated Nov 7, 1978. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070677-F)
94762	Karnak, R.E.; Kehr, C.C.; Hamelink, T.L.; et al. (1980) The Toxicity of Compound 94961 (Ethalfluralin) to Mallard Ducks in a 5-day Dietary Study: Study No. 7030-78. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070677-G)
92062003	Environ Corp. (1990) Dowelanco Phase 3 Summary of MRID 00094761. The Toxicity of Compound 94961 (Ethalfluralin) to Bobwhite Quail in a 5-Day Dietary Study: Project No. 7028-78. Prepared by LILLY RESEARCH LABS. 14 p.
92062004	Environ Corp. (1990) Dowelanco Phase 3 Summary of MRID 00094762. The Toxicity of Compound 94961 (Ethalfluralin) to Mallard Ducks in a 5-Day Dietary Study: Project No. 7030-78. Prepared by LILLY RESEARCH LABS. 14 p.

71-4 Avian Reproduction

MRID	Citation Reference
94763	Ringer, R.K.; Breslin, W.; Floga, C.; et al. (1981) The Toxicity of Ethalfluralin (El-161, Compound 94961) in a One-generation Reproduction Study with Mallards: Study AO2179. (Unpublished study received Feb 4, 1982 under 1471-122; prepared in cooperation with Michigan State Univ., submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL: 070677-H)
94764	Ringer, R.K.; Breslin, W.; Flaga, C.; et al. (1981) The Toxicity of Ethalfluralin (El-161, Compound 94961) in a One-generation Reproduction Study with Bobwhite: Study AO2079. (Unpublished study received Feb 4, 1982 under 1471-122; prepared in cooperation with Michigan State Univ., submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL: 070677-I)
92062005	Environ Corp. (1990) Dowelanco Phase 3 **Summary of MRID 00094764**. The Toxicity of Ethalfluralin (EL-161,Compound 94961) in One-generation Reproduction Study with Bobwhite Quail: Project No. A02079. Prepared by LILLY RESEARCH LABS. 18 p.
92062006	Environ Corp. (1990) Dowelanco Phase 3 **Summary of MRID 00094763**. The Toxicity of Ethalfluralin (EL-161, Compound 94961) in a One-generation Reproduction Study with Mallards: Study No. A02179. Prepared by LILLY RESEARCH LAB. 18 p.

72-1 Acute Toxicity to Freshwater Fish

MRID	Citation Reference
135183	Sleight, B. (1973) Acute Toxicity of 94961 to Bluegill, Rainbow Trout, and Goldfish (*Carassius auratus*). (Unpublished study received Aug 24, 1978 under 1471-EX-63; prepared by Bionomics, Inc., submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, IN; CDL:097325-F)
41460101	Murray, A.; Meyerhoff, R.; Grothe, D. (1990) Interim Report for An Acute Toxicity Study with Ethalfluralin and Bluegill *(Lepomis macrochirus*): Lab Project Number: F01190. Unpublished study prepared by Lilly Research Laboratories. 34 p.
41475001	Murray, A.; Meyerhoff, R.; Grothe, D. (1990) Summary Report for An Acute Toxicity Study with Ethalfluralin and Rainbow Trout (*Salmo gairdneri*): **Lab Project Number: F01090**. Unpublished study pre- pared by Lilly Research Laboratories. 34 p.
41613902	Murray, A. ; Grothe, D. ; Adams, E. (1990) The Acute Toxicity of Ethalfluralin to Bluegill (*Lepomis macrochirus*) in a Flow- through Test System: Lab Project Number: F02490. Unpublished study prepared by Lilly Research Labs. 2 p.
41613903	Murray, A. ; Grothe, D. ; Adams, E. (1990) The Acute Toxicity of Ethalfluralin to Rainbow Trout (*Salmo gairdneri*) in a Flow-through Test

	System: Lab Project Number: F02390. Unpublished study prepared by Lilly Research Labs. 48 p.
42176401	Murray, A.; Grothe, D.; Adams, E. (1992) The Acute Toxicity of Sonalan (FN 0802), a Formulation Containing Ethalfluralin (EL-161, Compound 094961), to Bluegill (*Lepomis macrochirus*) in a Static Renewal Test System: Lab Project Number: FO2391. Unpublished study prepared by Lilly Research Labs. 46 p.
41465901	Murray, A.; Meyerhoff, R.; Grothe, D. (1990) **Summary Report** for An Acute Toxicity Study with Ethalfluralin and Rainbow Trout (*Salmo gairdneri*): **Lab Project Number: F01090**. Unpublished study prepared by Lilly Research Laboratories. 34 p.
94769	Hamelink, J.L.; Kehr, C.C.; Adams, E.R.; et al. (1978) The Toxicity of Compound 94961 (El-161) to Bluegills in a 96 **Hour Soil-water Static Test:** Study No. 2111-78. Includes procedure no. 5801633 dated Sep 24, 1976. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070677-N)

72-2 Acute Toxicity to Freshwater Invertebrates

MRID	Citation Reference
94770	Karnak, R.E.; Kehr, C.C.; Hamelink, T.L.; et al. (1980) The Toxic- ity of Compound 94961 (Ethalfluralin) to *Daphnia magna* in a 48- hour Static Study: Study No. 5044-78. Includes procedure no. 5801633 dated Sep 24, 1976. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070677-O)
42176402	Grothe, D.; Adams, E. (1992) The Acute Toxicity of Sonalan EC (FN 0802), a Formulation Containing Ethalfluralin (EL-161, Compound 094961), to *Daphnia magna* in a Static-Renewal Test System: Lab Project Number: CO1191. Unpublished study prepared by Lilly Research Labs. 37 p.
92062007	Environ Corp. (1990) Dowelanco Phase 3 Summary of MRID 00094770. The Toxicity of Compound 94961 (Ethalfluralin) to *Daphnia magna* in a 48-Hour Static Study: Study No. 5044-78. Prepared by LILLY RESEARCH LABS. 12 p.

850.1735 Whole sediment: acute freshwater invertebrates

MRID	Citation Reference
48915701	Bradley, M. (2011) Ethalfluralin - 10-Day Toxicity Test Exposing Midge (*Chironomus dilutus*) to a Test Substance Applied to Sediment Under Static-Renewal Conditions. Project Number: 12550/6559, 101243. Unpublished study prepared by Smithers Viscient Laboratories. 99p.

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72-3 Acute Toxicity to Estuarine/Marine Organisms

MRID	Citation Reference
41613904	Sousa, J. (1990) Ethalfluralin--Acute Toxicity to Sheepshead Minnow (*Cyprinodon variegatus*) under Flow-through Conditions: Lab Project Number: SLI 90-7-3404: 1982. 1289. 6108. 505. Unpublished study prepared by Springborn Labs, Inc. 56 p.
41613905	Dionne, E. (1990) Ethalfluralin--Acute Toxicity to Eastern Oysters under Flow-through Conditions: Lab Project Number: SLI 90-07-338 1: 1982. 1289. 6107. 504. Unpublished study prepared by Spring- born Labs, Inc. 54 p.
41613906	Sousa, J. (1990) Ethalfluralin--Acute Toxicity to Mysid Shrimp (*Mysidopsis bahia*) under Flow-through Conditions: Lab Project Number: SLI 90-7-3405: 1982. 1289. 6106. 515. Unpublished study prepared by Springborn Labs, Inc. 56 p.
42889801	Ward, T.; Kowalski, P.; Boeri, R. (1993) Acute Flow-Through Mollusc Shell Deposition Test with Ethalfluralin: Lab Project Number: 186-DO: ES-2669. Unpublished study prepared by T. R. Wilbury Labs, Inc. 25 p.

72-4 Fish Early Life Stage/Aquatic Invertebrate Life Cycle Study

MRID	Citation Reference
41613907	Cocke, P.; Mohr, R.; Adams, E. (1990) The Chronic Toxicity of Ethalfluralin to *Daphnia magna* in a Flow-through Life Cycle Test: Lab Project Number: C00390. Unpublished study prepared by Lilly Research Labs. 69 p.
41994901	Murray, A.; Meyerhoff, R.; Adams, E. (1991) The Toxicity of Ethalfluralin to Rainbow Trout (*Salmo gairdneri*) in a 50-Day Early Life-Stage Study: Lab Project Number: F02690. Unpublished study prepared by Lilly Research Labs. 108 p.
42930101	Milazzo, D.; Servinski, M.; Kirk, H.; et al. (1993) Ethalfluralin: Evaluation of the Chronic Toxicity to the Daphnid, *Daphnia magna* Straus: Lab Project Number: 0233-3655: DECO-ES-2666. Unpublished study prepared by Dow Chemical Co. 49 p.

42041001	Sword, M.C. and J.L. Stratton (1991) Early Life-Stage Toxicity of RH-7592 Technical to Fathead Minnow (*Pimephales promelas*) under Flow-Through Conditions. ABC Report No. 39266. Rohm and Haas Report No. 91RC-0007. Study Conducted by Analytical Bio-Chemistry Laboratories, Inc., Columbia Mo. Submitted by Rohm and Haas, Spring House, PA. EPA MRID No. 42041001.

850.1300 Daphnid chronic toxicity test

MRID	Citation Reference
48509301	Breaux, N.; Douglas, M.; Chavez-Green, A.; et al. (2011) Dow AgroSciences Response to US EPAs Ethalfluralin Registration Review Docket EPA-OPP-2011-0094. Project Number: NTB053111/OCR. Unpublished study prepared by Dow AgroSciences, LLC. 29 p.
49086902	Urann, K. (2013) Ethalfluralin TGAI: Full Life-Cycle Toxicity Test with Water Fleas, *Daphnia magna*, Under Flow-Through Conditions. Project Number: 14050/6100, 120325. Unpublished study prepared by Smithers Viscient Laboratories. 102p.

850.1350 Mysid chronic toxicity test

MRID	Citation Reference
49037801	Dinehart, S. (2012) Ethafluralin Technical: Life-Cycle Toxicity Test of the Saltwater Mysid, *Americamysis bahia*, Conducted Under Flow-Through Conditions. Project Number: 68166, 101246. Unpublished study prepared by ABC Laboratories, Inc. 90p.

850.1400 Fish early-life stage toxicity test

MRID	Citation Reference
48689101	York, D. (2011) Ethalfluralin - Early Life-Stage Toxicity Test with Sheepshead Minnow (*Cyprinodon variegatus*). Project Number: 12550/6564, 101245. Unpublished study prepared by Smithers Viscient Laboratories. 79p.

0.1.1 72-7 Simulated or Actual Field Testing

MRID	Citation Reference
94769	Hamelink, J.L.; Kehr, C.C.; Adams, E.R.; et al. (1978) The Toxicity of Compound 94961 (El-161) to Bluegills in a 96 Hour Soil-water Static Test: Study No. 2111-78. Includes procedure no. 5801633 dated Sep 24, 1976. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by

Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070677-N)

122-1 Seed Germination/Seedling Emergence and Vegetable Vigor

MRID	Citation Reference
41613911	Waldrep, T. (1989) Influence of Ethalfluralin on the Germination of Seeds of Ten Crop Plants: Lab Project Number: 61989013. Unpublished study prepared by DowElanco. 13 p.

122-2 Aquatic plant growth

MRID	Citation Reference
41613912	Murray, A.; Grothe, D.; Adams, E. (1990) Toxicity of Ethalfluralin to a Freshwater Green Alga (*Selenastrum capricornutum*) in a Static Test System: Lab Project Number: J01190. Unpublished study prepared by Lilly Research Labs. 44 p.

123-1 Seed germination/seedling emergence and vegetative vigor

MRID	Citation Reference
41613913	Waldrep, T. (1990) Influence of Ethalfluralin Pre-emergence Spray on Seedling Emergence and Vegetative Vigor of Ten Crop Plants: Lab Project Number: 61990001. Unpublished study prepared by Dow- Elanco. 23 p.
41613914	Waldrep, T. (1989) Influence of Ethalfluralin Post-emergence Spray on the Vegetative Vigor of Ten Crop Plants: Lab Project Number: 61989014. Unpublished study prepared by DowElanco. 19 p.
42904201	Schwab, D. (1993) Evaluating the Effects of Ethalfluralin on the Vegetative Vigor of Non-Target Terrestrial Plants: Final Report: Lab Project Number: 40903: FAC-40903. Unpublished study prepared by ABC Labs, Inc. 86 p.
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850.4225 Seedling emergence, Tier II

MRID	Citation Reference
47874101	Rockliff, C. 2005 and 2008. First Amendment to Final Report: Evaluation of the Phytotoxicity of Sonalan (Ethalfluralin, 333 g ai/L, EC) Seedling Emergence and Seedling Growth Test (Based on OECD Guideline 208 A) – Northern Europe, 2005. Unpublished study performed by Stockbridge Technology Centre Ltd., North Yorkshire, UK. Laboratory Study No.: STC/05/E276. Study sponsored by Dow AgroSciences LLC, Indianapolis, Indiana. Sponsor Reference No.: EA05T1L001. Original study completed December 2005; Amendment to Report completed July 16, 2008.
49385904	Holou, M. (2013) Sonalan HFP (GF-1742 360 g a.s./L, EC): Effects on the Seedling Emergence and Growth of Non-Target Terrestrial Plants (Tier II). Project Number: 68750, 120537, 10/267065. Unpublished study prepared by ABC Laboratories, Inc. 160p.

850.4025 Target area phytotoxicity

MRID	Citation Reference
47874101	Rockliff, C. (2008) Evaluation of the Phytotoxicity of Sonalan (Enthalfluralin, 333g ai/l, EC) Seedling Emergence and Seedling Growth Test (Based on **OECD Guideline 208 A)** - Northern Europe, 2005: (First Amendment to Final Report). Project Number: STC/05/E276, EA05T1L001, 22156038. Unpublished study prepared by Stockbridge Technology Centre, Ltd. 100 p.

850.4025 Target area phytotoxicity

MRID	Citation Reference
47874101	Rockliff, C. (2008) Evaluation of the Phytotoxicity of Sonalan (Enthalfluralin, 333g ai/l, EC) Seedling Emergence and Seedling Growth Test (Based on OECD Guideline 208 A) - Northern Europe, 2005: (First Amendment to Final Report). Project Number: STC/05/E276, EA05T1L001, 22156038. Unpublished study prepared by Stockbridge Technology Centre, Ltd. 100 p.

850-4150 Terrestrial plant toxicity, Tier 1 (vegetative vigor)

MRID	Citation Reference

48509301	Breaux, N.; Douglas, M.; Chavez-Green, A.; et al. (2011) Dow AgroSciences Response to US EPAs Ethalfluralin Registration Review Docket EPA-OPP-2011-0094. Project Number: NTB053111/OCR. Unpublished study prepared by Dow AgroSciences, LLC. 29 p.
48915901	Sonalan HFP (Ethalfluralin, GF-1742, 360g as/L EC): Effects on Vegetative Vigor of Non-Target Terrestrial Plants (Tier II).

850.4400 Aquatic plant toxicity test using Lemna spp. Tiers I and II

MRID	Citation Reference
47866001	Hertl, J.; Breitwieser, H. (2009) Toxicity of Ethalfluralin Technical to the Aquatic Plant *Lemna gibba* in a Growth Inhibition Test. Project Number: 13052240. Unpublished study prepared by Institut fuer Biologische Analytik und Consulting IBACON. 76 p.
49086901	Softcheck, K. (2013) Ethalfluralin - 7-Day Toxicity Test with Duckweed (*Lemna gibba*). Project Number: 14050/6132, 120866. Unpublished study prepared by Smithers Viscient Laboratories. 105p.

141-1 Honey bee acute contact

MRID	Citation Reference
41613914	Hoxter, K.; Jaber, M. (1990) The Acute Contact of Ethalfluralin to the Honey Bee: Lab Project Number: 151-114. Unpublished study prepared by Wildlife International Ltd. 30 p.

850.6100 Environmental Chemistry Methods and Associated Independent Laboratory Validation

MRID	Citation Reference
49385901	Garcia-Alix, M. (2012) Independent Laboratory Validaiton of an Analytical Method for the Determination of Ethalfluralin in Soil. Project Number: 120138, CEMS/5394, 071040. Unpublished study prepared by CEM Analytical Services, Ltd. 70p.
49385902	Betson, S. (2012) Validation of an Analytical Method for the Determination of Ethalfluralin in Water. Project Number: 120814, CEMS/5608, 019/2002. Unpublished study prepared by CEM Analytical Services, Ltd. 123p.
49385903	Amic, S. (2013) Independent Laboratory Validation of an Analytical Method for the Determination of Ethalfluralin in Water by Gas

	Chromatography with Electron-Impact Mass Spectrometry Detection (GC/MS). Project Number: 130633, S13/01932, CEMS/5608. Unpublished study prepared by Eurofins Agroscience Services Chem SAS. 71p.

850.7100 Data reporting for environmental chemistry methods

MRID	Citation Reference
48915801	Dial, G. (2007) Validation Report for Method GRM 07.07 - Determination of Residues of Benfluralin, Ethalfluralin, and Trifluralin in Soil by Gas Chromatography with Electron-Impact Mass Spectrometry Detection. Project Number: 071040, GRM/07/07. Unpublished study prepared by Dow AgroSciences, LLC. 51p.

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94768	Karnak, R.E.; Kehr, C.C.; Hamelink, T.L; et al. (1980) The Toxicity of Compound 94961 (Ethalfluralin) to Earthworms in a 14- day Soil Incorporated Study: Study No. 6008-78. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070677-M)
94813	Kline, R.M.; Peloso, J.S.; Sieck, R.F.; et al. (1982) Microbial Interactions--The Effect of Ethalfluralin on Nitrogen Fixation by *Anabaena flos aquae*. (Unpublished study received Feb 4, 1982 under 1471-122; submitted by Elanco Products Co., Div. of Eli Lilly and Co., Indianapolis, Ind.; CDL:070676-M)
47899003	Effects of Ethalfluralin Technical on the Development of Sediment-Dwelling Larvae of *Chironomus riparius* in a Water-Sediment System.
48509301	Breaux, N.; Douglas, M.; Chavez-Green, A.; et al. (2011) Dow AgroSciences Response to US EPAs Ethalfluralin Registration Review Docket EPA-OPP-2011-0094. Project Number: NTB053111/OCR. Unpublished study prepared by Dow AgroSciences, LLC. 29 p.

Appendix C. Aquatic Exposure Modeling Inputs and Results

Surface Water Concentration Calculator (SWCC) Output Summary Table (all scenarios)

Scenario ID	Crops Represented	App. Date	App. Rate lb/A	Peak	Yr	overall	4-day	21-day	60-day	Pore Water Peak	Pore Water 21-day	Benthic Sdmnt. Peak	Benthic Sdmnt. 21-day
ILCornSTD	Soybean	10-Jun	1.31	4.61	0.11	0.09	3.17	1.36	0.62	0.19	0.15		
KSCornStd	Soybeam	10-Jun	1.31	5.94	0.16	0.12	4.27	2.25	0.93	0.30	0.24		
MScornSTD	Soybeam	10-Jun	1.31	4.69	0.20	0.12	3.33	1.90	1.01	0.23	0.17		
MSsoybeanSTD	Soybeam	10-Jun	1.31	4.51	0.17	0.11	3.32	1.82	0.89	0.22	0.16		
NCcornESTD	Soybeam	10-Jun	1.31	4.54	0.14	0.11	3.54	2.12	0.82	0.28	0.21		
OHCornSTD	Soybeam	10-Jun	1.31	4.51	0.12	0.10	3.23	1.39	0.65	0.21	0.16		
PAcornSTD	Soybeam	10-Jun	1.31	4.51	0.10	0.09	3.30	1.41	0.56	0.21	0.17		
ILCornSTD	Soybeam	25-Jun	1.31	4.52	0.11	0.09	3.29	1.54	0.63	0.22	0.17		
KSCornStd	Soybeam	25-Jun	1.31	4.56	0.16	0.11	3.61	1.67	0.81	0.24	0.17		
MScornSTD	Soybeam	25-Jun	1.31	4.59	0.20	0.13	3.49	1.96	0.97	0.20	0.16		
MSsoybeanSTD	Soybeam	25-Jun	1.31	4.51	0.17	0.11	3.42	1.88	0.89	0.19	0.15		
NCcornESTD	Soybeam	25-Jun	1.31	4.60	0.14	0.11	3.60	1.80	0.73	0.21	0.18		
OHCornSTD	Soybeam	25-Jun	1.31	5.23	0.12	0.10	3.66	1.67	0.63	0.24	0.18		

PAcornSTD	Soybeam	25-Jun	1.31	4.52	0.10	0.08	3.33	1.34	0.54	0.21	0.16		
ILCornSTD	Soybeam	10-Oct	1.31	4.57	0.12	0.10	3.26	1.31	0.61	0.23	0.19		
KSCornStd	Soybeam	10-Oct	1.31	5.35	0.15	0.11	3.82	1.60	0.82	0.27	0.22		
MScornSTD	Soybeam	10-Oct	1.31	**6.51**	0.25	0.18	4.71	2.60	1.27	0.37	0.30		
MSsoybeanSTD	Soybeam	10-Oct	1.31	6.05	0.22	0.15	4.30	2.34	1.06	0.33	0.27		
NCcornESTD	Soybeam	10-Oct	1.31	4.83	0.15	0.12	3.50	1.70	0.82	0.28	0.23		
OHCornSTD	Soybeam	10-Oct	1.31	4.51	0.15	0.11	3.36	1.35	0.68	0.23	0.19		
PAcornSTD	Soybeam	10-Oct	1.31	4.52	0.11	0.10	3.31	1.41	0.59	0.24	0.20		
ILCornSTD	Soybeam	25-Oct	1.31	4.60	0.13	0.10	3.28	1.37	0.63	0.25	0.22		
KSCornStd	Soybeam	25-Oct	1.31	4.52	0.14	0.11	3.30	1.74	0.75	0.30	0.26		
MScornSTD	Soybeam	25-Oct	1.31	5.42	0.26	0.18	4.21	2.11	1.36	0.38	0.34		
MSsoybeanSTD	Soybeam	25-Oct	1.31	5.06	0.22	0.16	3.99	1.96	1.21	0.35	0.29		
NCcornESTD	Soybeam	25-Oct	1.31	5.61	0.17	0.12	3.87	2.10	0.94	0.37	0.32		
OHCornSTD	Soybeam	25-Oct	1.31	4.51	0.17	0.13	3.43	1.66	0.78	0.29	0.25		
PAcornSTD	Soybeam	25-Oct	1.31	4.63	0.12	0.10	3.34	1.37	0.61	0.25	0.22		
ND Canola	Sunflower	15-May	1.70	5.91	0.10	0.09	4.11	1.42	0.59	0.29	0.24		
ND Canola	Sunflower	10-Jun	1.70	5.85	0.11	0.09	4.12	1.59	0.63	0.28	0.22		
ND Canola	Sunflower	10-Oct	1.70	5.85	0.11	0.09	4.08	1.50	0.57	0.30	0.26		
ND Canola	Sunflower	25-Oct	1.70	5.85	0.13	0.11	4.13	1.49	0.63	0.32	0.28	50.88	44.68
KS corn	Sunflower	15-May	1.70	6.10	0.20	0.15	4.56	1.90	1.06	0.30	0.25		

KS corn	Sunflower	10-Jun	1.70	7.69	0.21	0.16	5.53	2.92	1.20	0.38	0.31		
KS corn	Sunflower	10-Oct	1.70	6.94	0.19	0.14	4.95	2.07	1.06	0.35	0.28		
KS corn	Sunflower	25-Oct	1.70	5.85	0.19	0.14	4.27	2.25	0.97	0.38	0.34	60.90	54.38
FL Cucu	Cucurbits	15-Oct	1.70	8.49	0.24	0.15	5.68	2.59	1.33	0.32	0.23	51.52	37.05
FL Cucu	Cucurbits	30-Oct	1.70	12.50	0.25	0.15	8.34	3.55	1.36	0.49	0.33	77.59	52.79
FL Cucu	Cucurbits	30-Oct	0.75	5.52	0.11	0.06	3.68	1.57	0.60	0.15	34.23	23.29	0.00
FL Cucu	Cucurbits	30-Oct	1.13	8.28	0.16	0.10	5.55	2.36	0.91	0.33	0.22	51.68	35.14
NC Peanut	Peanut	1-May	1.15	4.12	0.11	0.09	3.32	1.37	0.57	0.23	0.19	36.252	30.05
MI Beans	Dry beans	15-May	1.69	5.90	0.13	0.11	4.28	1.69	0.71	0.31	0.26	49.29	41.82
ID Npotato	Potatoes	10-May	1.03	3.54	0.07	0.06	2.56	1.01	0.40	0.19	0.16	30.37	25.92
CA alfalfa-OP	Alfalfa, clover	10-Jan	1.69	5.81	0.15	0.13	4.44	2.09	0.96	0.40	0.37	63.92	57.88
		Maximum		***12.50***	***0.26***	***0.18***	***8.34***	***3.55***	***1.36***	***0.49***	***34.23***	***77.59***	***57.88***
		Minimum		***3.54***	***0.07***	***0.06***	***2.56***	***1.01***	***0.40***	***0.15***	***0.15***	***23.29***	***0.00***

Surface Water Modeling with the Surface Water Concentration Calculator (SWCC)

1. Sample Input / Output reports generated by SWCC – Comparison of 1 vs. 4 cm incorp. – Fl Cucumber Scenario

Table 1. Estimated Environmental Concentrations (ppb) for Ethalfluralin Fl cucumber scenario, Oct. 30 annual applications, comparison of conservative at 1 cm versus incorporated to 4 cm depth assumptions.

EEC Exposure Duration	At 1 cm depth	Incorp. To 4 cm depth
Peak (1-in-10 yr)	12.4	8.92
4-day Avg (1-in-10 yr)	8.29	6.13
21-day Avg (1-in-10 yr)	3.50	2.72
60-day Avg (1-in-10 yr)	1.34	1.03
365-day Avg (1-in-10 yr)	0.244	0.184
Entire Simulation Mean	0.146	0.120

a. Application fully Incorporated to 4 cm.

Estimated Environmental Concentrations for Ethalfluralin are presented in Table 1 for the USEPA standard pond with the FLcucumberSTD field scenario. A graphical presentation of the year-to-year peaks is presented in Figure 1. These values were generated with the Surface Water Concentration Calculator (SWCC Version 1.106). Critical input values for the model are summarized in Tables 2 and 3.

This model estimates that about 1.2% of Ethalfluralin applied to the field eventually reaches the water body. The main mechanism of transport from the field to the water body is by spray drift (53.3% of the total transport), followed by runoff (43.6%) and erosion (3.18%).

In the water body, pesticide dissipates with an effective water column half-life of 4.7 days. (This value does not include dissipation by transport to the benthic region; it includes only processes that result in removal of pesticide from the complete system.) The main source of dissipation in the water column is volatilization (effective average half-life = 6.2 days) followed by photolysis (22.6 days) and metabolism (104.3 days).

In the benthic region, pesticide dissipates (5.1 days). The main source of dissipation in the benthic region is metabolism (effective average half-life = 5.1 days). The vast majority of the pesticide in the benthic region (99.77%) is sorbed to sediment rather than in the pore water.

Table 1. Estimated Environmental Concentrations (ppb) for Ethalfluralin.

Peak (1-in-10 yr)	8.92
4-day Avg (1-in-10 yr)	6.13
21-day Avg (1-in-10 yr)	2.72
60-day Avg (1-in-10 yr)	1.03
365-day Avg (1-in-10 yr)	0.184
Entire Simulation Mean	0.120

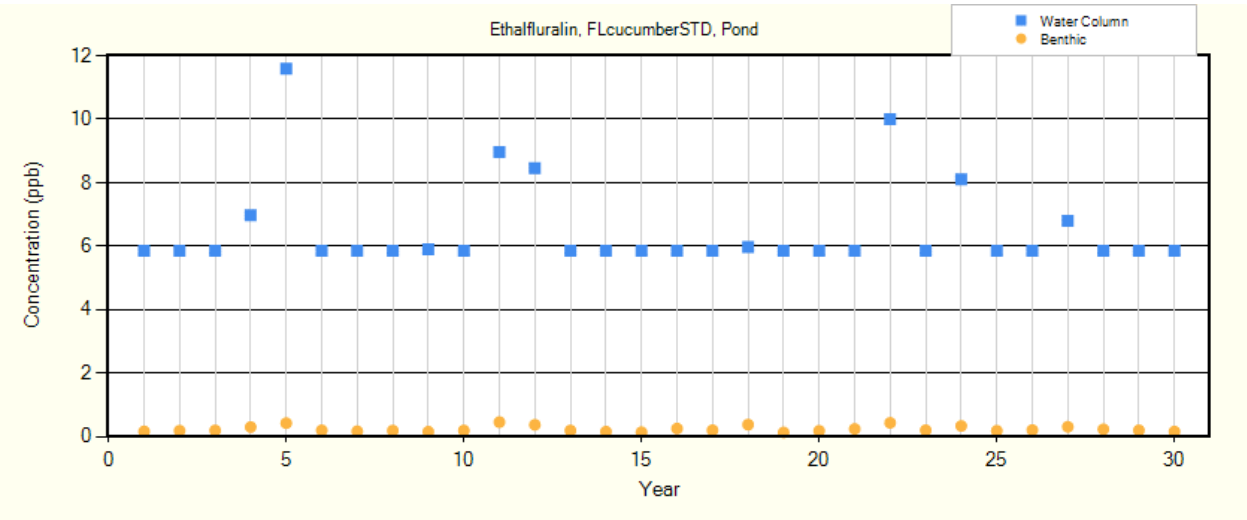
Table 2. Summary of Model Inputs for Ethalfluralin.

Scenario	FLcucumberSTD
Cropped Area Fraction	1
Koc (ml/g)	3957
Water Half-Life (days) @ 25 °C	97
Benthic Half-Life (days) @ 25 °C	4.75
Photolysis Half-Life (days) @ 40 °Lat	0.263
Hydrolysis Half-Life (days)	0
Soil Half-Life (days) @ 25 °C	48.5
Foliar Half-Life (days)	0
Molecular Wt	333.27
Vapor Pressure (torr)	8.3e-5
Solubility (mg/l)	0.3

Table 3. Application Schedule for Ethalfluralin.

Date (Mon/Day)	Type	Amount (kg/ha)	Eff.	Drift
10/30	Incorporated to 4 cm	1.91	0.99	0.062

Figure 1. Yearly Peak Concentrations



a. Application fully placed at a 1 cm depth (Assumption used in EEC calculations for all scenarios)

Summary of Water Modeling of Ethalfluralin 48asm no vol 4cm-ap and the USEPA Standard Pond FL cucumber dept 1 cm

Estimated Environmental Concentrations for Ethalfluralin 48asm no vol 4cm-ap are presented in Table 1 for the USEPA standard pond with the FLcucumberSTD field scenario. A graphical presentation of the year-to-year peaks is presented in Figure 1. These values were generated with the Pesticide Water Calculator (PWC), Version 1.52. Critical input values for the model are summarized in Tables 2 and 3.

This model estimates that about 1.4% of Ethalfluralin 48asm no vol 4cm-ap applied to the field eventually reaches the water body. The main mechanism of transport from the field to the water body is by runoff (55.6% of the total transport) followed by spray drift (44.4%).

In the water body, pesticide dissipates with an effective water column half-life of 4.7 days. (This value does not include dissipation by transport to the benthic region; it includes only processes that result in removal of pesticide from the complete system.) The main source of dissipation in the water column is volatilization (effective average half-life = 6.3 days) followed by photolysis (22.6 days) and metabolism (104.3 days).

In the benthic region, pesticide dissipates (5.1 days). The main source of dissipation in the benthic region is metabolism (effective average half-life = 5.1 days). The vast majority of the pesticide in the benthic region (99.77%) is sorbed to sediment rather than in the pore water.

Table 1. Estimated Environmental Concentrations (ppb) for Ethalfluralin 48asm no vol 4cm-ap.

Peak (1-in-10 yr)	12.4

4-day Avg (1-in-10 yr)	8.29
21-day Avg (1-in-10 yr)	3.50
60-day Avg (1-in-10 yr)	1.34
365-day Avg (1-in-10 yr)	0.244
Entire Simulation Mean	0.146

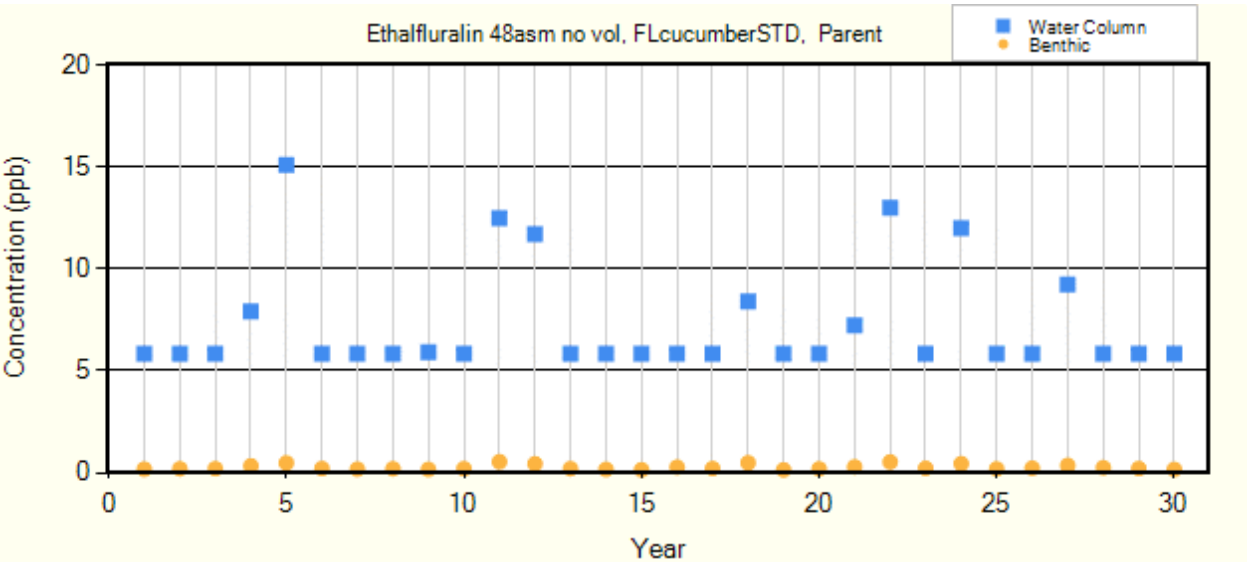
Table 2. Summary of Model Inputs for Ethalfluralin 48asm no vol 4cm-ap.

Scenario	FLcucumberSTD
Cropped Area Fraction	1
Koc (ml/g)	3957
Water Half-Life (days) @ 25 °C	97
Benthic Half-Life (days) @ 25 °C	4.75
Photolysis Half-Life (days) @ 40 °Lat	0.263
Hydrolysis Half-Life (days)	0
Soil Half-Life (days) @ 25 °C	48
Foliar Half-Life (days)	0
Molecular Weight	333.27
Vapor Pressure (torr)	8.2E-5
Solubility (mg/l)	0.3
Henry's Constant	0.0049

Table 3. Application Schedule for Ethalfluralin 48asm no vol 4cm-ap.

Date (Mon/Day)	Type	Amount (kg/ha)	Eff.	Drift
10/30	Placed at a depth of 4 cm	1.905	.99	.062

Figure 1. Yearly Peak Concentrations



2. Sample Output Summary files – SWCC and PWC

SWCC

1. Sunflower and other Oilseed Crop Use Exposure Asssessment – KScorn Scenario

\
File Name: SWCC_ethalfl-RR2015_KSCorn_Reserv+Pond_Jun10app (rep sunflower) 48.5dASM-97dWC_KSCornStd_Pond_Parent.txt

Variable Volume Water Model, SWCC Compatible Version

****
Performed on: 1/19/2016 at 18:25

Peak 1-in-10 = 7.69 ppb
Chronic 1-in-10 = 0.211 ppb
Simulation Avg = 0.155 ppb
4-day avg 1-in-10 = 5.51 ppb
21-day avg 1-in-10 = 2.90 ppb
60-day avg 1-in-10 = 1.19 ppb
90-day avg 1-in-10 = 0.800 ppb

Benthic Pore Water Peak 1-in-10 = 0.381 ppb
Benthic Pore Water 21-day avg 1-in-10 = 0.302 ppb

Benthic Conversion Factor = 159. -Pore water (ug/L) to (total mass, ug)/(dry sed mass,kg)
Benthic Mass Fraction in Pore Water = 0.233E-02

YEAR	Peak	4-day	21-day	60-day	90-day	Yearly Avg	Benthic Pk	Benthic 21-day
1	5.85E+00	4.20E+00	1.50E+00	7.49E-01	5.12E-01	1.43E-01	2.55E-01	1.79E-01
2	5.85E+00	3.92E+00	1.57E+00	6.79E-01	5.47E-01	1.45E-01	2.14E-01	1.66E-01
3	5.85E+00	4.00E+00	1.48E+00	6.62E-01	4.47E-01	1.11E-01	2.36E-01	1.64E-01
4	5.85E+00	4.65E+00	2.09E+00	7.66E-01	6.25E-01	1.70E-01	3.21E-01	2.30E-01
5	5.85E+00	4.14E+00	1.77E+00	8.12E-01	5.68E-01	1.57E-01	2.36E-01	1.81E-01
6	7.73E+00	5.56E+00	2.47E+00	9.19E-01	6.48E-01	1.60E-01	3.81E-01	2.76E-01
7	9.28E+00	6.83E+00	4.35E+00	1.74E+00	1.16E+00	3.05E-01	5.55E-01	4.48E-01
8	7.04E+00	4.64E+00	1.79E+00	1.04E+00	7.87E-01	2.06E-01	2.96E-01	2.10E-01
9	7.73E+00	5.62E+00	2.65E+00	9.99E-01	6.69E-01	1.71E-01	3.77E-01	3.07E-01
10	6.59E+00	4.50E+00	1.52E+00	5.54E-01	3.71E-01	1.11E-01	2.55E-01	1.74E-01
11	6.65E+00	4.50E+00	1.58E+00	6.04E-01	4.03E-01	1.12E-01	2.64E-01	1.81E-01
12	5.85E+00	3.45E+00	1.18E+00	5.31E-01	3.85E-01	1.12E-01	1.86E-01	1.25E-01
13	5.85E+00	3.60E+00	1.14E+00	8.69E-01	6.14E-01	2.06E-01	2.03E-01	1.33E-01
14	5.85E+00	4.02E+00	1.38E+00	5.67E-01	4.22E-01	1.17E-01	2.30E-01	1.60E-01
15	6.36E+00	4.21E+00	1.41E+00	5.08E-01	3.47E-01	1.02E-01	2.35E-01	1.60E-01
16	5.85E+00	3.54E+00	1.09E+00	4.29E-01	2.87E-01	7.44E-02	1.89E-01	1.24E-01
17	6.90E+00	4.96E+00	3.19E+00	1.25E+00	9.35E-01	2.49E-01	4.16E-01	3.03E-01
18	5.85E+00	3.40E+00	1.57E+00	6.40E-01	4.41E-01	1.30E-01	1.98E-01	1.62E-01
19	5.85E+00	4.04E+00	1.64E+00	9.01E-01	6.59E-01	1.75E-01	2.36E-01	1.73E-01
20	5.85E+00	3.90E+00	1.19E+00	4.77E-01	3.58E-01	1.11E-01	2.06E-01	1.28E-01
21	7.05E+00	5.12E+00	2.11E+00	1.07E+00	7.44E-01	1.97E-01	2.86E-01	2.13E-01
22	5.85E+00	4.25E+00	1.86E+00	9.42E-01	6.79E-01	1.75E-01	2.73E-01	2.25E-01
23	5.85E+00	3.90E+00	1.57E+00	6.08E-01	4.06E-01	1.14E-01	2.31E-01	1.74E-01
24	7.33E+00	4.96E+00	2.92E+00	1.20E+00	8.01E-01	2.12E-01	3.73E-01	2.92E-01
25	5.85E+00	3.96E+00	1.40E+00	6.82E-01	5.18E-01	1.58E-01	2.27E-01	1.59E-01
26	5.85E+00	3.87E+00	1.46E+00	6.48E-01	5.01E-01	1.38E-01	2.22E-01	1.57E-01
27	5.85E+00	4.55E+00	1.85E+00	7.31E-01	5.45E-01	1.42E-01	2.55E-01	1.84E-01
28	5.85E+00	4.01E+00	1.49E+00	6.71E-01	4.57E-01	1.16E-01	2.21E-01	1.51E-01
29	5.85E+00	4.03E+00	1.72E+00	8.15E-01	6.30E-01	1.89E-01	2.31E-01	1.83E-01
30	5.89E+00	3.71E+00	1.51E+00	6.71E-01	5.14E-01	1.33E-01	2.31E-01	1.65E-01

****
****
Effective compartment halflives averaged over simulation duration:

zero washout 0
water col metab halflife (days) = 186.982755893926
zero hydrolysis 0
photolysis halflife (days) = 30.8989226773054
volatile halflife (days) = 8.71834121390727
total water col halflife (days) = 6.56114624506848

zero burial 0
benthic metab halflife (days) = 9.15637206697060
zero benthic hydrolysis 0
total benthic halflife (days) = 9.15637206697060
****
Fractional Contribution of Transport Processes to Waterbody & Total Mass (kg):

Due to Runoff = 0.5039 3.599
Due to Erosion = 0.0000 0.000
Due to Drift = 0.4961 3.543
****
Flow in/out Characteristics of Waterbody:
Average Daily Runoff Into Waterbody (m3/s) = 8.385461856625667E-004
Baseflow Into Waterbody (m3/s) = 0.000000000000000E+000
Average Daily Flow Out of Waterbody (m3/s) = 8.385461856625857E-004
****
Inputs:
3957. = oc partitioning coefficient
97.00 = water column half Life
25.00 = reference temp for water column degradation
4.750 = benthic Half Life
25.00 = Reference temp for benthic degradation
2.000 = Q ten value
0.2630 = photolysis half life
40.00 = reference latitude for photolysis study
0.000 = hydrolysis half life
333.3 = molecular wt
0.8200E-04 = vapor pressure
0.3000 = solubility
0.1000E+06 = field area
0.1000E+05 = water body area
2.000 = initial depth
2.000 = maximum depth
2 1=vvwm, 2=usepa pond, 3 = usepa reservoir, 4 = const vol no flow, 5 = const vol w/flow
F T = burial, else no burial
0.1000E-07 = mass transfer coefficient
0.5000 = PRBEN
0.5000E-01 = benthic compartment depth
0.5000 = benthic porosity
1.350 = benthic bulk density
0.4000E-01 = OC frcation in benthic sediment
5.000 = DOC in benthic compartment
0.6000E-02 = benthic biomass
1.190 = DFAC
30.00 = SS

0.5000E-02 = chlorophyll
0.4000E-01 = OC frcation in water column SS
5.000 = DOC in water column
0.4000 = biomass in water column
FRACTION AREA CROPPED = 1.00000000000000

PWC Sample Output File (with volatilization invoked)

ariable Volume Water Model, Version 1.02000000000000

****
Performed on: 2/23/2016 at 13:36

Peak 1-in-10.0 = 7.74 ppb
Chronic 1-in-10.0 = 0.219 ppb
Simulation Avg = 0.161 ppb
4-d avg 1-in-10.0 = 5.60 ppb
21-d avg 1-in-10.0 = 2.98 ppb
60-d avg 1-in-10.0 = 1.22 ppb
90-d avg 1-in-10.0 = 0.825 ppb
1-d avg 1-in-10.0 = 7.02 ppb
Benthic Pore Water Peak 1-in-10.0 = 0.392 ppb
Benthic Pore Water 21-d avg 1-in-10.0 = 0.309 ppb
Benthic Conversion Factor = 159. -Pore water (ug/L) to (total mass, ug)/(dry sed mass,kg)
Benthic Mass Fraction in Pore Water = 0.233E-02

YEAR	Peak	4-day	21-day	60-day	90-day	Yearly Avg	Benthic Pk	Benthic 21-day
1	5.85E+00	4.28E+00	1.58E+00	7.80E-01	5.33E-01	1.50E-01	2.64E-01	1.87E-01
2	5.85E+00	3.95E+00	1.61E+00	6.95E-01	5.58E-01	1.49E-01	2.17E-01	1.70E-01
3	5.85E+00	4.05E+00	1.53E+00	6.80E-01	4.58E-01	1.15E-01	2.42E-01	1.69E-01
4	5.85E+00	4.72E+00	2.17E+00	7.95E-01	6.45E-01	1.77E-01	3.28E-01	2.38E-01
5	5.85E+00	4.18E+00	1.82E+00	8.35E-01	5.84E-01	1.62E-01	2.40E-01	1.86E-01
6	7.84E+00	5.65E+00	2.57E+00	9.57E-01	6.73E-01	1.67E-01	3.93E-01	2.86E-01
7	9.35E+00	6.97E+00	4.51E+00	1.81E+00	1.21E+00	3.19E-01	5.74E-01	4.64E-01
8	7.04E+00	4.76E+00	1.89E+00	1.07E+00	8.13E-01	2.13E-01	3.09E-01	2.21E-01
9	7.78E+00	5.71E+00	2.77E+00	1.05E+00	7.02E-01	1.80E-01	3.91E-01	3.20E-01
10	6.67E+00	4.64E+00	1.62E+00	5.89E-01	3.94E-01	1.17E-01	2.67E-01	1.84E-01
11	6.65E+00	4.58E+00	1.64E+00	6.28E-01	4.19E-01	1.18E-01	2.72E-01	1.87E-01
12	5.85E+00	3.52E+00	1.22E+00	5.49E-01	3.97E-01	1.17E-01	1.92E-01	1.30E-01
13	5.85E+00	3.72E+00	1.22E+00	8.94E-01	6.31E-01	2.16E-01	2.13E-01	1.41E-01
14	5.85E+00	4.07E+00	1.43E+00	5.85E-01	4.35E-01	1.22E-01	2.35E-01	1.65E-01
15	6.36E+00	4.28E+00	1.46E+00	5.29E-01	3.60E-01	1.08E-01	2.41E-01	1.66E-01
16	5.85E+00	3.66E+00	1.16E+00	4.57E-01	3.05E-01	7.99E-02	1.98E-01	1.32E-01
17	6.97E+00	5.03E+00	3.25E+00	1.27E+00	9.51E-01	2.54E-01	4.23E-01	3.09E-01
18	5.85E+00	3.53E+00	1.64E+00	6.68E-01	4.60E-01	1.36E-01	2.08E-01	1.70E-01

19	5.85E+00	4.11E+00	1.71E+00	9.33E-01	6.80E-01	1.81E-01	2.43E-01	1.81E-01
20	5.85E+00	3.96E+00	1.23E+00	4.91E-01	3.65E-01	1.16E-01	2.10E-01	1.32E-01
21	7.10E+00	5.20E+00	2.19E+00	1.10E+00	7.63E-01	2.04E-01	2.95E-01	2.21E-01
22	5.85E+00	4.32E+00	1.95E+00	9.86E-01	7.08E-01	1.84E-01	2.82E-01	2.36E-01
23	5.85E+00	4.01E+00	1.67E+00	6.45E-01	4.31E-01	1.23E-01	2.43E-01	1.84E-01
24	7.39E+00	5.06E+00	3.01E+00	1.24E+00	8.26E-01	2.20E-01	3.84E-01	3.00E-01
25	5.85E+00	4.02E+00	1.46E+00	7.02E-01	5.32E-01	1.64E-01	2.32E-01	1.65E-01
26	5.85E+00	3.93E+00	1.51E+00	6.67E-01	5.13E-01	1.42E-01	2.28E-01	1.63E-01
27	5.86E+00	4.58E+00	1.88E+00	7.43E-01	5.52E-01	1.44E-01	2.58E-01	1.87E-01
28	5.85E+00	4.06E+00	1.52E+00	6.86E-01	4.66E-01	1.19E-01	2.25E-01	1.55E-01
29	5.85E+00	4.09E+00	1.78E+00	8.40E-01	6.47E-01	1.96E-01	2.36E-01	1.89E-01
30	5.89E+00	3.82E+00	1.60E+00	7.00E-01	5.34E-01	1.39E-01	2.42E-01	1.73E-01

****

Effective compartment halflives averaged over simulation duration:

zero washout 0
water col metab halflife (days) = 186.982755893926
zero hydrolysis 0
photolysis halflife (days) = 30.8989226773054
volatile halflife (days) = 11.0708851226495
total water col halflife (days) = 7.81013932066613

zero burial 0
benthic metab halflife (days) = 9.15637206697060
zero benthic hydrolysis 0
total benthic halflife (days) = 9.15637206697060

****

Fractional Contribution of Transport Processes to Waterbody & Total Mass (kg):

Due to Runoff = 0.5042 3.603
Due to Erosion = 0.0000 0.1157E-26
Due to Drift = 0.4958 3.543

****

Flow in/out Characteristics of Waterbody:
Average Daily Runoff Into Waterbody (m3/s) = 8.391564781242711E-004
Baseflow Into Waterbody (m3/s) = 0.000000000000000E+000
Average Daily Flow Out of Waterbody (m3/s) = 8.391564781242700E-004

****

Inputs:
3957. = oc partitioning coefficient
97.00 = water column half Life
25.00 = reference temp for water column degradation
4.750 = benthic Half Life
25.00 = Reference temp for benthic degradation
2.000 = Q ten value

0.2630 = photolysis half life
40.00 = reference latitude for photolysis study
0.000 = hydrolysis half life
333.3 = molecular wt
0.8200E-04 = vapor pressure
0.3000 = solubility
0.1000E+06 = field area
0.1000E+05 = water body area
2.000 = initial depth
2.000 = maximum depth
2 1=vvwm, 2=usepa pond, 3 = usepa reservoir, 4 = const vol no flow, 5 = const vol w/flow
F T = burial, else no burial
0.1000E-07 = mass transfer coefficient
0.5000 = PRBEN
0.5000E-01 = benthic compartment depth
0.5000 = benthic porosity
1.350 = benthic bulk density
0.4000E-01 = OC frcation in benthic sediment
5.000 = DOC in benthic compartment
0.6000E-02 = benthic biomass
1.190 = DFAC
30.00 = SS
0.5000E-02 = chlorophyll
0.4000E-01 = OC frcation in water column SS
5.000 = DOC in water column
0.4000 = biomass in water column
FRACTION AREA CROPPED = 1.00000000000000

Sample SWCC Input Files

2. Sunflower and other Oilseed Crop Use Exposure Asssessment – KScorn Scenario

File Name: SWCC_ethalfl-RR2015_KSCorn_Reserv+Pond_Jun10app (rep sunflower) 48.5dASM-97dWC.SWI

Ethalfluralin
1
True
3957,,,
97,,,
25,,,
4.75,,,
25,,,

0.263,,,
40,,,
0,,,
48.5,,,
25,
0,,,
333.27,,,
8.2E-5,,,
0.3,,,
0,0,
0,0,
0,0,
0,0,
0,0,
0,0,

2
1
10,,
6,,
1.905,,
False
,,
4,,
,,
,,
.99,,
.062,,
.99,,
.0661,,
1,,
,,
True
,,

KSCornStd
C:\Models\Inputs\Metfiles\W13996.dvf

True,True,False,False,False
False,30
False
10000

12
4.2
4.8
1E-08
0.5
0.05
0.5
1.35
0.04
5
0.006
1.19
30
0.005
0.04
5
0.4
False
1.0,1.0

10
5
9
7
20
10
90,300
100
0.25
1
0.72
0.36
17.5
0

0.37
0.58
0.5
3
3.4
600
4
10,8,8,66,
1.3,1.3,1.3,1.29,

0.364,0.364,0.274,0.32,
0.139,0.139,0.224,0.229,
1.74,1.74,1.3,0.87,
100,4,4,33,
,,,,
,,,,

False
29
10,16,1,16,1,16,1,16,1,16,1,16,1,5,16,1,16,1,16,1,16,1,16,1,16,1,16,1,10,16,20,25,1,,,,,,,,,,,,,,,,,,,,,,
5,5,6,6,7,7,8,8,9,9,10,10,10,11,11,12,12,1,1,2,2,3,3,4,4,4,4,4,5,,,,,,,,,,,,,,,,,,,,,,
88,88,88,88,88,88,88,88,88,88,88,88,88,94,94,94,94,94,94,94,94,94,94,94,94,94,94,94,94,,,,,,,,,,,
,,,,,,,,,,,
.189,.195,.151,.122,.101,.107,.115,.122,.130,.150,.178,.099,.106,.096,.084,.087,.089,.038,.038,.0
39,.039,.040,.042,.044,.090,.094,.160,.184,.189,,,,,,,,,,,,,,,,,,,,,,
.023,.023,.023,.023,.023,.023,.023,.023,.023,.023,.023,.023,.023,.023,.023,.023,.023,.023,.023,.0
23,.023,.023,.023,.023,.023,.023,.023,.023,.023,,,,,,,,,,,,,,,,,,,,,,
2.0,1.55,0.266,
0.1,0,
False

3. Cucurbits Use Exposure Asssessment – FL Cucumber Scenario (Oct. 30 application date)

File Name: SWCC_ethalfl-RR2015_FLcucu_Reserv+Pond_Oct30 app (rep Cucurb)48.5dASMH2O97d.SWI

Ethalfluralin B test
1
True
3957,,,
97,,,
25,,,
4.75,,,
25,,,
0.263,,,
40,,,
0,,,
48.5,,,
25,
0,,,
333.27,,,
8.2E-5,,,
0.3,,,

0,0,
0,0,
0,0,
0,0,
0,0,
0,0,

2
1
30,,
10,,
1.905,,
False
,,
4,,
,,
,,
.99,,
.062,,
.99,,
.0661,,
1,,
,,
True
,,

FLcucumberSTD
C:\Models\Inputs\Metfiles\W12844.dvf

True,True,False,False,False
False,30
False
10000
12
4.2
4.8
1E-08
0.5
0.05
0.5
1.35
0.04

5
0.006
1.19
30
0.005
0.04
5
0.4
False
1.0,1.0

16
10
5
12
10
12
50,30
80
0.15
1
0.78
0
32.5
0

0.03
0.2
1
4
1
600
3
10,62,28,
1.65,1.65,1.7,
0.073,0.073,0.211,
0.023,0.023,0.091,
1.16,1.16,0.174,
100,31,7,
,,,
,,,

False

27
16,1,16,1,16,1,16,1,16,1,16,1,16,1,15,16,25,1,16,1,16,1,10,16,1,16,1,,,,,,,,,,,,,,,,,,,,,,,
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Appendix D. Sample TREX Files

Upper Bound Kenaga Residues For RQ Calculation

Chemical Name:	Ethalfluralin	
Use	24	
Formulation	0	
Application Rate	1.69	lbs a.i./acre
Half-life	35	days
Application Interval	0	days
Maximum # Apps./Year	1	
Length of Simulation	1	year
Variable application rates?	no	

Endpoints			
Avian	Redwinged blackbird	LD50 (mg/kg-bw)	2000.00
	Bobwhite quail	LC50 (mg/kg-diet)	5000.00
	Bobwhite quail	NOAEL(mg/kg-bw)	0.00
	Mallard duck	NOAEC (mg/kg-diet)	1000.00
Mammals		LD50 (mg/kg-bw)	5000.00
		LC50 (mg/kg-diet)	0.00
		NOAEL (mg/kg-bw)	61.00
		NOAEC (mg/kg-diet)	1220.00

Dietary-based EECs (ppm)	Kenaga Values
Short Grass	405.60
Tall Grass	185.90
Broadleaf plants	228.15
Fruits/pods/seeds	25.35
Arthropods	158.86

Dose-based EECs (mg/kg-bw)	Avian Classes and Body Weights (grams)		
	small	mid	large
	20	100	1000
Short Grass	461.94	263.42	117.94
Tall Grass	211.72	120.73	54.05
Broadleaf plants	259.84	148.17	66.34
Fruits/pods	28.87	16.46	7.37
Arthropods	180.93	103.17	46.19
Seeds	6.42	3.66	1.64

Dose-based RQs (Dose-based EEC/adjusted LD50)	Avian Acute RQs Size Class (grams)		
	20	100	1000
Short Grass	0.27	0.12	0.04
Tall Grass	0.13	0.06	0.02
Broadleaf plants	0.15	0.07	0.02
Fruits/pods	0.02	0.01	0.00
Arthropods	0.11	0.05	0.02
Seeds	0.00	0.00	0.00

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	RQs	
	Acute	Chronic
Short Grass	0.08	0.41
Tall Grass	0.04	0.19
Broadleaf plants	0.05	0.23
Fruits/pods/seeds	0.01	0.03
Arthropods	0.03	0.16

	Mammalian Classes and Body weight (grams)

Dose-Based EECs (mg/kg-bw)	15	35	1000
Short Grass	386.71	267.27	61.97
Tall Grass	177.24	122.50	28.40
Broadleaf plants	217.52	150.34	34.86
Fruits/pods	24.17	16.70	3.87
Arthropods	151.46	104.68	24.27
Seeds	5.37	3.71	0.86

Dose-based RQs (Dose-based EEC/LD50 or NOAEL)	small	medium	large
	Chronic	Chronic	Chronic
Short Grass	2.88	2.46	1.32
Tall Grass	1.32	1.13	0.61
Broadleaf plants	1.62	1.39	0.74
Fruits/pods	0.18	0.15	0.08
Arthropods	1.13	0.97	0.52
Seeds	0.04	0.03	0.02

Dietary-based RQs (Dietary-based EEC/LC50 or NOAEC)	Mammal RQs	
	Acute	Chronic
Short Grass	#DIV/0!	0.33
Tall Grass	#DIV/0!	0.15
Broadleaf plants	#DIV/0!	0.19
Fruits/pods/seeds	#DIV/0!	0.02
Arthropods	#DIV/0!	0.13

Appendix E. Sample TerrPlant Files

Table 1. Chemical Identity.	
Chemical Name	Ethalfluralin

PC code	**113101**
Use	**alfalfa**
Application Method	**Spray**
Application Form	**Ground Application**
Solubility in Water (ppm)	**0.3**

Table 2. Input parameters used to derive EECs.

Input Parameter	Symbol	Value	Units
Application Rate	A	**1.3**	**y**
Incorporation	I	**2**	none
Runoff Fraction	R	**0.01**	none
Drift Fraction	D	**0**	none

Table 3. EECs for Ethalfluralin. Units in y.

Description	Equation	EEC
Runoff to dry areas	(A/I)*R	0.0065
Runoff to semi-aquatic areas	(A/I)*R*10	0.065
Spray drift	**A*D**	**0**
Total for dry areas	**((A/I)*R)+(A*D)**	**0.0065**
Total for semi-aquatic areas	**((A/I)*R*10)+(A*D)**	**0.065**

Table 4. Plant survival and growth data used for RQ derivation. Units are in y.

Plant type	Seedling Emergence		Vegetative Vigor	
	EC_{25}	NOAEC	EC_{25}	NOAEC
Monocot	**0.0183**	**0.00195**	**0.212**	**0.053**
Dicot	**0.139**	**0.105**	**0.27**	**0.027**

Table 5. RQ values for plants in dry and semi-aquatic areas exposed to Ethalfluralin through runoff and/or spray drift.*

Plant Type	Listed Status	Dry	Semi-Aquatic	Spray Drift

Monocot	non-listed	0.36	3.55	<0.1
Monocot	listed	3.33	33.33	<0.1
Dicot	non-listed	<0.1	0.47	<0.1
Dicot	listed	<0.1	0.62	<0.1
*If RQ > 1.0, the LOC is exceeded, resulting in potential for risk to that plant group.				

Appendix F. Sample KABAM Files

Table 11. Estimated concentrations of Ethalfluralin in ecosystem components.				
Ecosystem Component	**Total concentration (µg/kg-ww)**	**Lipid normalized concentration (µg/kg-lipid)**	**Contribution due to diet (µg/kg-ww)**	**Contribution due to respiration (µg/kg-ww)**
Water (total)*	13	N/A	N/A	N/A
Water (freely dissolved)*	13	N/A	N/A	N/A
Sediment (pore water)*	0	N/A	N/A	N/A
Sediment (in solid)**	52	N/A	N/A	N/A
Phytoplankton	72,690	3634482	N/A	72,689.64
Zooplankton	56,920	1897330	2,222.15	54,697.75
Benthic Invertebrates	61,641	2054701	5,607.68	56,033.37
Filter Feeders	40,471	2023530	3,612.90	36,857.70
Small Fish	94,288	2357210	24,355.55	69,932.85
Medium Fish	115,675	2891869	48,653.60	67,021.15
Large Fish	174,190	4354746	107,805.01	66,384.81
* Units: µg/L; **Units: µg/kg-dw				

Table 12. Total BCFand BAF values of Ethalfluralin in aquatic trophic levels.		
Trophic Level	**Total BCF (µg/kg-ww)/(µg/L)**	**Total BAF (µg/kg-ww)/(µg/L)**
Phytoplankton	6184	5815
Zooplankton	4407	4554
Benthic Invertebrates	4578	4931
Filter Feeders	3010	3238
Small Fish	5889	7543
Medium Fish	5889	9254
Large Fish	6191	13935

Table 13. Lipid-normalized BCF, BAF, BMF and BSAF values of Ethalfluralin in aquatic trophic levels.				
Trophic Level	**BCF (µg/kg-lipid)/(µg/L)**	**BAF (µg/kg-lipid)/(µg/L)**	**BMF (µg/kg-lipid)/(µg/kg-lipid)**	**BSAF (µg/kg-lipid)/(µg/kg-OC)**
Phytoplankton	309225	290759	N/A	2782
Zooplankton	146889	151786	0.52	1452

Benthic Invertebrates	152604	164376	1.13	1573
Filter Feeders	150475	161882	1.11	1549
Small Fish	147235	188577	1.19	1804
Medium Fish	147235	231350	1.31	2214
Large Fish	154769	348380	1.51	3334

Table 14. Calculation of EECs for mammals and birds consuming fish contaminated by Ethalfluralin.

Wildlife Species	Biological Parameters				EECs (pesticide intake)	
	Body Weight (kg)	Dry Food Ingestion Rate (kg-dry food/kg-bw/day)	Wet Food Ingestion Rate (kg-wet food/kg-bw/day)	Drinking Water Intake (L/d)	Dose Based (mg/kg-bw/d)	Dietary Based (ppm)
Mammalian						
fog/water shrew	0.02	0.140	0.585	0.003	36.074	61.64
rice rat/star-nosed mole	0.1	0.107	0.484	0.011	31.659	65.43
small mink	0.5	0.079	0.293	0.048	33.929	115.67
large mink	1.8	0.062	0.229	0.168	26.510	115.67
small river otter	5.0	0.052	0.191	0.421	22.102	115.67
large river otter	15.0	0.042	0.157	1.133	27.371	174.19
Avian						
sandpipers	0.0	0.228	1.034	0.004	67.9830	65.75
cranes	6.7	0.030	0.136	0.211	9.9245	73.03
rails	0.1	0.147	0.577	0.010	45.0152	77.96
herons	2.9	0.040	0.157	0.120	13.9553	88.66
small osprey	1.3	0.054	0.199	0.069	23.0669	115.67
white pelican	7.5	0.029	0.107	0.228	18.5864	174.19

Table 15. Calculation of toxicity values for mammals and birds consuming fish contaminated by Ethalfluralin.

Wildlife Species	Toxicity Values	
	Acute	Chronic

	Dose Based (mg/kg-bw)	Dietary Based (mg/kg-diet)	Dose Based (mg/kg-bw)	Dietary Based (mg/kg-diet)
Mammalian				
fog/water shrew	10499.51	N/A	128.09	1220
rice rat/star-nosed mole	7122.50	N/A	86.89	1220
small mink	4695.52	N/A	57.29	1220
large mink	3320.24	N/A	40.51	1220
small river otter	2571.84	N/A	31.38	1220
large river otter	1954.18	N/A	23.84	1220
Avian				
sandpipers	1440.86	0.00	N/A	1000
cranes	3446.50	0.00	N/A	1000
rails	1738.73	0.00	N/A	1000
herons	3039.67	0.00	N/A	1000
small osprey	2679.19	0.00	N/A	1000
white pelican	3505.31	0.00	N/A	1000

Table 16. Calculation of RQ values for mammals and birds consuming fish contaminated by Ethalfluralin.

Wildlife Species	Acute		Chronic	
	Dose Based	Dietary Based	Dose Based	Dietary Based
Mammalian				
fog/water shrew	0.003	N/A	0.282	0.051
rice rat/star-nosed mole	0.004	N/A	0.364	0.054
small mink	0.007	N/A	0.592	0.095
large mink	0.008	N/A	0.654	0.095
small river otter	0.009	N/A	0.704	0.095
large river otter	0.014	N/A	**1.148**	0.143

Avian				
sandpipers	0.047	#DIV/0!	N/A	0.066
cranes	0.003	#DIV/0!	N/A	0.073
rails	0.026	#DIV/0!	N/A	0.078
herons	0.005	#DIV/0!	N/A	0.089
small osprey	0.009	#DIV/0!	N/A	0.116
white pelican	0.005	#DIV/0!	N/A	0.174

Appendix G. Risk Quotient Method

Risk characterization integrates the results of the exposure and ecotoxicity data to evaluate the likelihood of adverse ecological effects. The means of this integration is called the quotient method. Risk quotients (RQs) are calculated by dividing exposure estimates by acute and chronic ecotoxicity values.

RQ = EXPOSURE/TOXICITY

RQs are then compared to OPP's levels of concern (LOCs). These LOCs are used by OPP to analyze potential risk to nontarget organisms and the need to consider regulatory action. The criteria indicate that a pesticide used as directed has the potential to cause adverse effects on nontarget organisms. LOCs currently address the following risk presumption categories: (1) acute risks - regulatory action may be warranted in addition to restricted use classification, (2) acute restricted use - the potential for acute risk is high, but may be mitigated through restricted use classification, (3) acute endangered species - endangered species may be adversely affected, and (4) chronic risk - the potential for chronic risk is high regulatory action may be warranted. Currently, EFED does not perform assessments for chronic risk to plants, acute or chronic risks to insects, or chronic risk from granular/bait formulations to birds or mammals.

The ecotoxicity test values (measurement endpoints) used in the acute and chronic risk quotients are derived from required studies. Examples of ecotoxicity values derived from short-term laboratory studies that assess acute effects are: (1) LC_{50} (fish and birds), (2) LD_{50} (birds and mammals), (3) EC_{50} (aquatic plants and aquatic invertebrates) and (4) EC_{25} (terrestrial plants). Examples of toxicity test effect levels derived from the results of long-term laboratory studies that assess chronic effects are: (1) LOAEL or LOAEC (birds, fish, and aquatic invertebrates) and (2) NOAEL or NOAEC (birds, fish and aquatic invertebrates). For birds, mammals, fish and aquatic invertebrates the NOAEL or NOAEC generally is used as the ecotoxicity test value in assessing chronic effects, although other values may be used when justified. Risk presumptions and the corresponding RQs and LOCs, are tabulated below.

Table X. Risk presumptions for terrestrial animals based on risk quotients (RQ) and levels of concern (LOC).

Risk Presumption	RQ	LOC
	Birds	
Acute Risk	**EEC[1]/LC_{50} or LD_{50}/ft^2 or LD_{50}/day[3]**	**0.5**
Acute Restricted Use	**EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day (or LD_{50} < 50 mg/kg)**	**0.2**
Acute Endangered Species	**EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day**	**0.1**
Chronic Risk	**EEC/NOAEC**	**1**
	Wild Mammals	
Acute Risk	**EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day**	**0.5**
Acute Restricted Use	**EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day (or LD_{50} < 50 mg/kg)**	**0.2**
Acute Endangered Species	**EEC/LC_{50} or LD_{50}/ft^2 or LD_{50}/day**	**0.1**
Chronic Risk	**EEC/NOAEC**	**1**

[1] abbreviation for Estimated Environmental Concentration (ppm) on avian/mammalian food items
[2] mg/ft^2
[3] mg of toxicant consumed/day
LD_{50} * wt. of bird
LD_{50} * wt. of bird

Table 2. Risk presumptions for aquatic animals based on risk quotients (RQ) and levels of concern (LOC).

Risk Presumption	RQ	LOC
Acute Risk	**EEC[1]/LC_{50} or EC_{50}**	**0.5**
Acute Restricted Use	**EEC/LC_{50} or EC_{50}**	**0.1**
Acute Endangered Species	**EEC/LC_{50} or EC_{50}**	**0.05**
Chronic Risk	**EEC/NOAEC**	**1**

[1] EEC = (ppm or ppb) in water

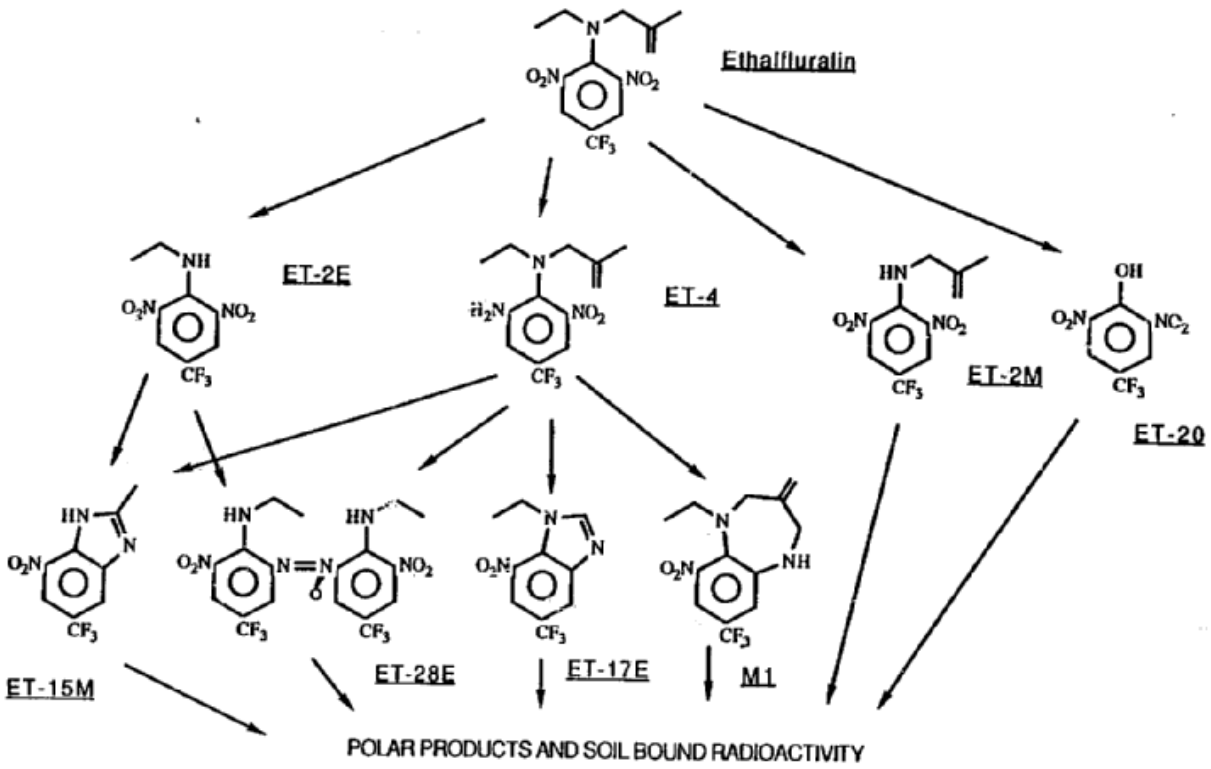
Table 3. Risk presumptions for plants based on risk quotients (RQ) and levels of concern (LOC).

Risk Presumption	RQ	LOC
	Terrestrial and Semi-Aquatic Plants	
Acute Risk	EEC[1]/EC_{25}	1
Acute Endangered Species	EEC/EC_{05} or NOAEC	1
	Aquatic Plants	
Acute Risk	EEC[2]/EC_{50}	1
Acute Endangered Species	EEC/EC_{05} or NOAEC	1

[1] EEC = lbs ai/A
[2] EEC = (ppb/ppm) in water

Appendix H. Environmental Degradates of Ethalfluralin

Proposed Pathway for Aerobic Degradation of Ethalfluralin (Source: MRID 41613918)



CHEMICAL NAMES OF DEGRADATES

ET-2E = N-Ethyl-2,6-dinitro-4- (trifluoromethyl)benzenamine

ET-4 = N2-Ethyl-N2-(2-methyl-2-propenyl)-3-nitro-5- (trifluoromethyl)-1,2-benzenediamine

ET-2M = N-(2-Methyl-2-propenyl)- 2,6-dinitro-4-(trifluoromethyl)benzenamine

ET-20 = 2,6-Dinitro-4-(trifluoromethyl)phenol

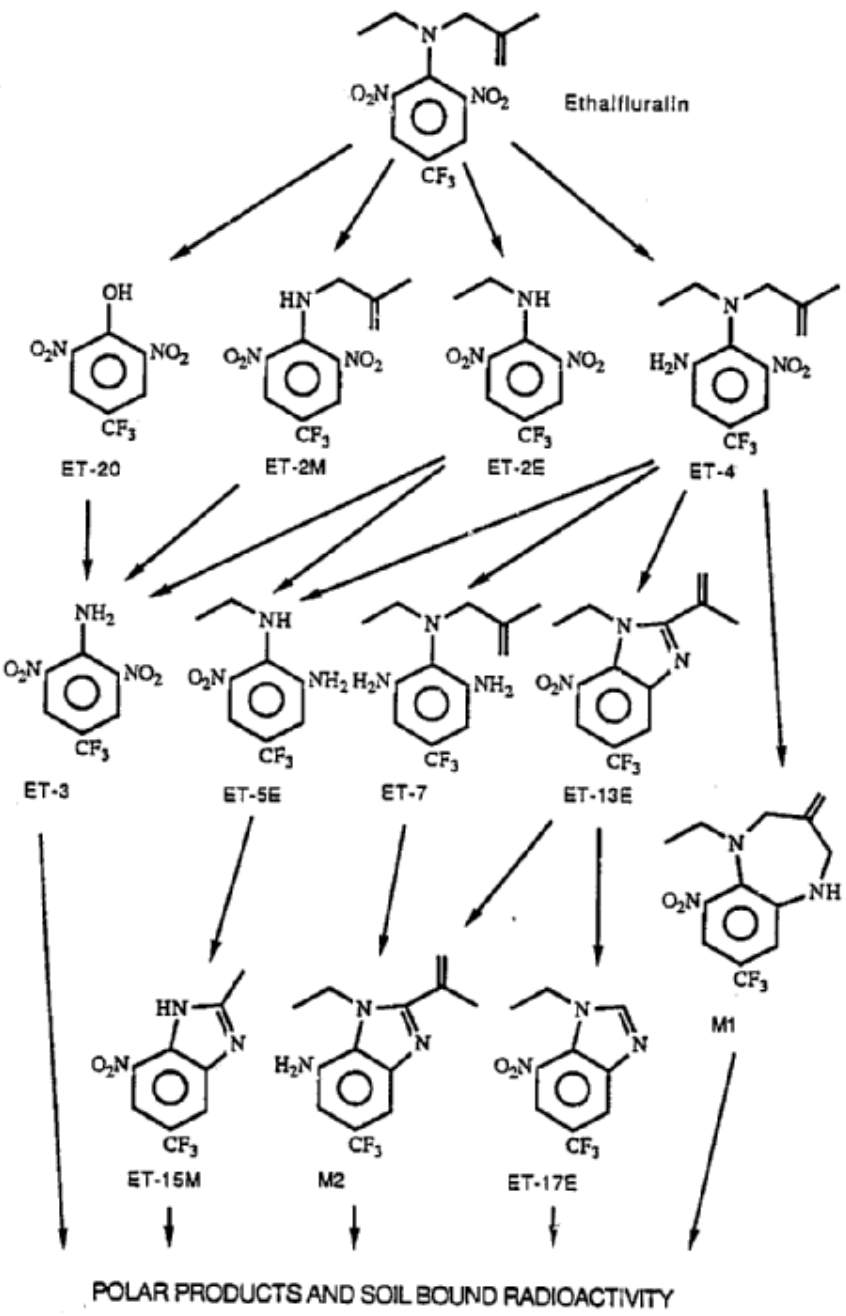
ET-15M = 2-Methyl-7-nitro-5-(trifluoromethyl)benzimidazole

ET-28E = 2,2'-Azoxybis(α,α,α-trifluoro-6-nitro-N-ethyl-p-toluldine)

ET-17E = 1 -Ethyl-7-nitro-5-(trifluoromethyl)benzimidazole

M1 = 2,3,4,5-Tetrahydro-5-ethyl-3-methylene-6-nitro-8-(trifluoromethyl)-1H-1,5-benzodiazepine

Proposed Pathway for Anaerobic Degradation of Ethalfluralin (Source: MRID 41613919)



CHEMICAL NAMES OF DEGRADATES (not previously listed)
ET-3 = 2,6-Dinitro-4-(trifluoromethyl)benzenamine
ET-5E = N^2-Ethyl-3-nitro-5-(trifluoromethyl)-1,2-benzenediamine
ET-7 = N^2-Ethyl-N^2-(2-methyl-2-propenyl-5-(trifluoromethyl)-1,2,3-benzenetriamine
ET-13E = 1-Ethyl-2-(1-methylethenyl) -7-nitro-5-(trifluoromethyl)benzimidazole
M2 = 1-Ethyl-2-(1-methylethenyl)-5-(trifluoromethyl)-1H-benzimidazol-7-amine